



## Evolution of the New Economy Business Model

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This paper documents and analyzes the evolution of the “New Economy business model” (NEBM) over the past half century. Through the high-tech boom, bust, and recovery of the past decade, the NEBM has emerged as dominant in the U.S. information and communication technology industries, and elements of the NEBM have spread abroad. Strategy, finance, and organization are distinctive in the NEBM compared with the Old Economy business model (OEBM) that had evolved during the first half of the twentieth century. Strategically, the NEBM is highly focused on specific products and processes in contrast to horizontal diversification and vertical integration under the OEBM. Financially, under the NEBM, firms tend to pay no dividends, using all their retained earnings to fund growth. When they have grown large, however, NEBM firms engage in repeated large-scale stock repurchases so that they can better use their stock as a currency to acquire technology companies and, in the form of stock options, to compensate a broad base of employees. Organizationally, these employees tend to be highly educated, and routine production activities are automated and outsourced. The NEBM stresses the interfirm mobility of labor and the globalization of employment, with increasingly higher value-added activities being performed outside the United States. In historical perspective, the NEBM is the end of the “organization man.”

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The Internet boom of the last half of the 1990s seemed to herald the arrival of a “New Economy” with its promise that, after the stagnation of the early 1990s, innovation in information and communication technologies (ICT) would regenerate economic prosperity. The subsequent collapse of the Internet boom at the beginning of the 2000s called into question the New Economy’s ability to deliver on this promise—and raised questions about whether there had really been anything “new” about the economy of the late 1990s after all. Perhaps the journalist John Cassidy was correct to entitle his well-documented book on the Internet

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boom “dot.con: the greatest story ever sold.”<sup>1</sup> If the New Economy was just all smoke and mirrors, one would expect that, once the debris left behind by the storm of speculation and corruption had been cleared away, economic life would return to what it had been before the boom took place.

It is now clear that there was plenty of e-con in the New Economy. At the same time, however, there was something new, important, and permanent about the New Economy that transformed the economic lives of many. The core of that something new and important is what I call the “New Economy Business Model” (NEBM), a mode of organizing business enterprises that has changed, perhaps dramatically, the ways and terms of people’s employment. These changes in employment relations emanated from Silicon Valley and spread primarily to other regions of the United States. They also affected, to a lesser extent, other parts of the world, especially Europe and Asia, as U.S.-based ICT companies extended their global reach and as high-tech companies based outside the United States sought to adopt elements of NEBM. By the 2000s, the ICT labor force had become vastly more globalized than it had been before the Internet revolution.

Since the end of the Internet boom, NEBM has by no means disappeared. Rather, its characteristic features have become more widespread and entrenched in the U.S. ICT industries. With its startup firms, vertical specialists, venture capital, and highly mobile labor, it is a business model that remains dominant in the United States and that many national policymakers around the world seek to emulate. At the same time, within the United States, it is a business model that has been associated with volatile stock markets, unequal incomes, and unstable employment, including most recently, even during a period of economic growth, the insecurity associated with the “offshoring” of high-skill ICT jobs. We need to understand the organizational and industrial dynamics of NEBM, if only to determine how tapping its innovative capability might be rendered compatible with socially desirable outcomes.

The “Old Economy Business Model” (OEBM) is best described as one based on the “organization man.” Popularized in the United States in the 1950s, the stereotypical “organization man” obtained a college education, got a well-paying job with an established company early in his career, and

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<sup>1</sup> John Cassidy, *dot.con: The Greatest Story Ever Sold* (New York, 2002).

then worked his way up and around the corporate hierarchy over decades of employment, with a substantial defined-benefit pension, complete with highly subsidized medical coverage, awaiting him on retirement.<sup>2</sup> The employment stability offered by an established corporation was highly valued, while interfirm labor mobility was shunned.

Ironically, in the 1980s, when formidable Japanese competitors confronted U.S.-based Old Economy companies, many U.S. observers of Japan's "lifetime employment" system viewed it as a mode of economic organization that was quite alien to the American way of life. Yet, in the post-World War II decades, U.S. business corporations had their own versions of lifetime employment, complete with what the Japanese call "salarymen." U.S. corporations over the course of the twentieth century transformed the salaried professional, technical, and administrative employees who peopled the managerial structure into organization men. By the 1950s and 1960s, moreover, one could even apply the term to those "hourly" production workers whose long-term relations with the companies for which they worked were mediated by industrial unions and collective bargaining.

From this historical perspective, NEBM can best be described as "the end of the organization man." It is not that New Economy companies have ceased to rely on the integration of the hierarchical and functional divisions of labor that seek to transform large numbers of individuals into a productive organization. Indeed, one might argue that, given heightened technological complexity and market competition in the world of ICT, the building of unique organizational capabilities has become more, not less, critical to the success of the enterprise than before. Nor is it necessarily the case that employees who spend their entire careers with one company have become an endangered species. Rather, what is new is the lack of commitment on the part of U.S. high-tech companies to providing their employees with stable employment, skill formation, and rewarding careers. When an employee begins to work for a high-tech company in the New Economy, he or she has no expectation of a career with that particular enterprise. Interfirm labor mobility can bring other benefits to an employee, however, including working for a smaller company, choice of geographical location in which to work, and employee stock options as a potential source of income. The New Economy business model represents dramatically diminished organizational commitment on both sides of the employment relation compared to its Old Economy predecessor.

A corollary of this diminution in organizational commitment in NEBM has been an increased globalization of the types of labor that U.S.-based ICT firms employ. This globalization of labor has occurred through the international mobility of high-tech labor and the offshoring of high-tech work, both of which have intensified over the past decade or so. The employment relations of major U.S.-based ICT companies have become

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<sup>2</sup> William H. Whyte, *The Organization Man* (New York, 1956).

thoroughly globalized, based on corporate strategies that benefit not only from lower wages, but also from the enhancement of ICT skill levels in non-U.S. locations such as India, China, and Russia.

While the extent of the impact of NEBM on ICT employment has become evident only within the last several years, NEBM itself has taken almost a half-century to unfold. Indeed, its origins can be found in the mid-1950s at precisely the time when the Old Economy U.S. industrial corporation was at the pinnacle of its power. The development of computer chips from the late 1950s provided the technological foundation for the microcomputer revolution from the late 1970s, which in turn created the technological infrastructure for the commercialization of the Internet in the 1990s. While the U.S. government and the research laboratories of established Old Economy corporations played major, and indeed, indispensable roles in supporting these developments, each wave of innovation generated opportunities for the emergence of startup companies that were to become central to the commercialization of the new technologies.

The regional concentration of these new ventures in what became known as Silicon Valley reinforced the emergence of a distinctive business model. From the late 1960s, venture capitalists backed so many high-tech startups near Stanford University that they created a completely new industry for financing the entry and initial growth of technology firms. These startups lured “talent” from established companies by offering them compensation in the form of stock options, typically as a partial substitute for salaries, with the potential payoff being the high market value of the stock after an initial public offering or the private sale of the young firm to an established corporation. As these young companies grew, annual grants of stock options to a broad base of potentially highly mobile people became an important tool for retaining existing employees as well as for attracting new ones. The subsequent growth of these companies occurred, moreover, not only by investing additional capital in new facilities and hiring more people, but also by acquiring even newer high-tech companies, almost invariably using stock rather than cash as the acquisition currency. In addition, wherever and whenever possible, ICT companies, which as systems integrators designed, tested, and marketed final products, outsourced manufacturing of components so that they could focus on higher value-added work. This outsourcing strategy became both more economical and more efficient over time as contract manufacturers developed their capabilities, including global organizations and highly automated production processes, for a larger extent of the market.

These features of the new ICT business model were already evident to industry observers in the late 1980s. It was only during the Internet boom of the last half of the 1990s, however, that the ICT model had a sufficient impact on product market competition and resource allocation, including interfirm labor mobility, to give popular definition to a “New Economy.”

### Business Models and the ICT Industries

A business model can be characterized by its *strategy*—the types of product markets for which a company competes and the types of production processes through which it generates goods and services for these markets; its *finance*—the ways in which it funds investments in processes and products until they can generate financial returns; and its *organization*—the ways in which it elicits skill and effort from its labor force to add value to those investments. As captured in the writings of Joseph A. Schumpeter, Edith T. Penrose, Alfred D. Chandler, Jr., and John Kenneth Galbraith, the power of OEBM coming into the second half of the twentieth century lay in the ability of already successful firms to routinize innovation and thereby to build on their superior capabilities in existing product markets to move into new product markets.<sup>3</sup> In contrast, a characteristic feature of NEBM since the 1950s has been the prominence, and even dominance, of new firms as innovators in the ICT industries. R&D is important in both OEBM and NEBM, but, whereas investments in *research* drove product innovation in OEBM, investments in *development* are much more important in NEBM. In the New Economy, firms that can focus quickly on developing products for specialized new markets have an advantage that has favored highly focused new entrants over diversified going concerns.

In the transformation of inputs into outputs, one of the strengths of OEBM was vertical integration.<sup>4</sup> To ensure the quality and quantity of critical raw materials and intermediate goods that firms needed for final products, firms took direct control over upstream activities in the value chain. In contrast, a characteristic feature of NEBM has been the vertical specialization of the value chain based on a highly structured set of standards that enable the systemic integration into complex products of components produced by firms in the various vertical layers of an industry. By narrowing the range of processes in which a firm invests, vertical specialization of production processes enhances the ability of a firm to mobilize its resources to compete for specialized product markets. In terms of both products and processes, therefore, NEBM entails a much higher degree of strategic focus than OEBM.

How do these new firms come into existence? In the Old Economy there were no identifiable financial institutions devoted to the financing of startups; finance for new ventures came informally from personal savings

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<sup>3</sup> Joseph A. Schumpeter, *Capitalism, Socialism, and Democracy* (New York, 1942); Edith T. Penrose, *The Theory of the Growth of the Firm* (Oxford, U.K., 1959); Alfred D. Chandler, Jr., *Strategy and Structure: Chapters in the History of the American Industrial Enterprise* (Cambridge, Mass., 1962), and John Kenneth Galbraith, *The New Industrial State* (Boston, Mass., 1967).

<sup>4</sup> Alfred D. Chandler, Jr., *The Visible Hand: The Managerial Revolution in American Business* (Cambridge, Mass., 1977); Alfred D. Chandler, Jr., *Scale and Scope: The Dynamics of Industrial Capitalism* (Cambridge, Mass., 1990).

of the entrepreneurs, their family members, and business associates. If and when these new ventures transformed themselves into going concerns with a record of sustained profitability, they tended to go public on the New York Stock Exchange (NYSE), with its stringent listing requirements. Once listed, these companies tended to pay regular dividends to shareholders. In contrast, in the New Economy a specialized set of venture-capital institutions arose from the 1960s to finance the startup of high-tech firms so that by the beginning of the 1970s “venture capital” had emerged as an industry in its own right.<sup>5</sup> The creation in 1971 of the National Association of Securities Dealers Automated Quotation (NASDAQ) system out of the existing over-the-counter markets made it possible for firms to go public on a nationally traded and hence highly liquid stock market that had much less stringent listing requirements than the NYSE. The existence of NASDAQ enabled venture capitalists to exit from their investments much more quickly than if the new firms had listed on the NYSE. And unlike the allocation of profits under OEEM, New Economy companies have tended not to pay dividends, thus increasing the amount of internal sources available to fund their growth, while rendering the returns to shareholders wholly dependent on the appreciation of a company’s stock price.

Finally, as already indicated, OEEM was known for its reliance on the capabilities and commitment of the “organization man” who tended to spend his career moving up and around one corporate hierarchy. The label attached to professional, technical, and administrative employees who generally had a bachelor’s degree or higher and were paid on a salaried basis. Yet even through the 1970s blue-collar workers, who were classified as “hourly” employees (which meant that they were “non-exempt” from the labor law that obligates an employer to pay an employee 150 percent of the hourly rate when he or she works overtime), could realistically hold out the expectation that they would spend their entire work lives with one company and that they would retire with good incomes and medical coverage based on defined-benefit pension plans. Within the United States, NEEM employees have been predominantly highly educated professional, technical, and administrative personnel remunerated on a salaried basis. New Economy firms have tended to offshore routine manufacturing operations to low-wage areas of the world and/or to outsource such operations in the United States to highly automated companies.

Moreover, the professional, technical, and managerial employees are no longer “organization men.” Rather they tend to be highly mobile on the

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<sup>5</sup> For the origins of organized venture capital in the United States, see John W. Wilson, *The New Venturers: Inside the High-Stakes World of Venture Capital* (Reading, Mass., 1985), chap. 2; David H. Hsu and Martin Kenney, “Organizing Venture Capital: The Rise and Demise of American Research & Development, 1946-1973,” unpub. working paper, 5 Sept. 2004.

labor market, with interfirm mobility taken as the norm. Although many employees of New Economy firms may in fact stay with one company over the course of their careers, commitment between the company and the employee is not expected from the employment relation. To induce mobility to, and reduce mobility from, the firm, New Economy companies have offered stock options to a broad base of employees—not just to top executives, as was the practice in OEBM. In NEBM, employees have “defined contribution” 401(k) pensions, which, as private accounts, are portable from one firm to another. The employer contributions to these pensions are often minimal, and their ultimate value is dependent on the performance of securities markets. In NEBM, it has also been assumed that gains from the exercise of stock options (which are, of course, dependent on the increase of the company’s stock price) will help to provide the employee with a “nest egg” that can fund income and benefits when the employee retires from the labor force.

For each of these characteristics of NEBM, there were discernible historical breaks in the organization of the ICT industries that make the distinction between the Old Economy and New Economy a meaningful one. At the same time, Old Economy and New Economy companies still compete with one another, with many Old Economy corporations adopting elements of NEBM in recent years.<sup>6</sup> One needs to understand the historical origins of NEBM, I would argue, to comprehend the organizational dynamics of the U.S.-based ICT industries and their implications for the evolution of ICT employment opportunities.

The evolution of NEBM has been intimately related to the development of the ICT industries in the United States since the 1960s. The U.S. Department of Commerce defines the ICT industries as those engaged in producing computer hardware, computer software and services, communications equipment, and communications services.<sup>7</sup> ICT industries are high-productivity industries. In 2002 GDP from ICT industries was 8.0 percent of U.S. Gross Domestic Product (GDP), almost two and a half times ICT’s share of employment in the U.S. civilian labor force.<sup>8</sup> In that year, ICT accounted for 5.5 percent of U.S. exports of goods

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<sup>6</sup> See Marie Carpenter, William Lazonick, and Mary O’Sullivan, “The Stock Market and Innovative Capability in the New Economy: The Optical Networking Industry,” *Industrial and Corporate Change* 12 (2003): 963-1034.

<sup>7</sup> The U.S. Department of Commerce describes these industries as IT (Information Technology). I use the term ICT to describe the same set of industries in order to highlight the organizational separation of information and communication technologies in OEBM and the ongoing convergence of information and communication technologies that characterizes NEBM. See U.S. Department of Commerce, Economics and Statistics Administration, 2003, *The Digital Economy 2003*, online at <https://www.esa.doc.gov/2003.cfm>.

<sup>8</sup> U.S. Census Bureau, *Statistical Abstract of the United States: 2003* (Washington, D.C., 2003), 385.

and services, 7.2 percent of imports, and 11.3 percent of the trade deficit.<sup>9</sup> The fact that the 2002 ICT trade deficit was \$47.3 billion was to some degree the result of the globalization of investment and employment in ICT value chains, with U.S.-based companies playing leading roles; it cannot be assumed that the trade deficit measures U.S. lack of competitiveness in ICT industries. U.S.-based ICT firms spend substantial amounts on innovation, accounting for 26.0 percent of all company-funded R&D in the United States in 2000 and 31.2 percent in 2001. Employees in ICT industries earn, on average, much more than those in most other sectors of the economy. Even in 2002, with earnings in ICT industries somewhat depressed relative to earnings in the U.S. economy as a whole, the average annual income of an employee in ICT industries was \$67,440 (ranging from \$37,750 in electronic capacitor manufacturing to \$99,440 in software publishing), compared with \$36,250 in all private-sector industries.<sup>10</sup>

From 1993 to 2000, employment in U.S. ICT industries increased by 51.9 percent, compared with a 20.8 percent increase for all private-sector industries. In 2000, these industries employed a total of 5.38 million people, representing 4.8 percent of employment by all U.S. private-sector industries. While ICT employment declined by 0.6 percent in 2001 and 10.7 percent in 2002, at the end of 2002 the ICT industries employed 4.78 million people, or 4.4 percent of employment in the U.S. private sector.<sup>11</sup> Clearly, ICT is very important to the growth and prosperity of the U.S. economy.

Within ICT, it is possible, with some reservations, to classify major companies as “Old Economy” and “New Economy” according to when the companies were founded (see Tables 1 and 2).<sup>12</sup> For inclusion in Table 2, a company had to a) be founded in 1955 or later, b) not have been established by the spin-off of an existing division from an Old Economy company, and c) not have grown through acquisition of, or merger with, an Old Economy company. I have chosen 1955 as the earliest date for inclusion in the list because that was the year that Shockley Semiconductor Laboratories was established in Mountain View, California, by William Shockley, the co-inventor of the transistor. As is

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<sup>9</sup><http://www.census.gov/foreign-trade/statistics/product/atp/2003/12/atpc-try/atpg04.html>; <http://www.census.gov/foreign-trade/statistics/historical/gands.pdf>.

<sup>10</sup> U.S. Department of Commerce, Economics and Statistics Administration, 2003, *The Digital Economy 2003*, online at <https://www.esa.doc.gov/2003.cfm> Appendix Table 2.3.

<sup>11</sup> Sandra D Cooke, “Information Technology Workers in the Digital Economy,” in U.S. Department of Commerce, *The Digital Economy 2003*, chap. 2, online at <https://www.esa.doc.gov/2003.cfm>.

<sup>12</sup> In 2003, the 103 ICT companies in the Fortune 1000 list had 10.6 percent of the revenues of all companies in the list.

well known, the Shockley startup sparked a chain reaction that resulted in the emergence of Silicon Valley as a center for the development of computer electronics. Note the predominance in Table 2 of California-based companies, as well as of information technology (as distinct from communication technology) companies. While a number of important NEBM companies, most notably Microsoft, are located outside Silicon Valley, I would argue that, in the absence of Silicon Valley, NEBM would not have emerged as a durable, much less as a dominant, business model.

Table 1 lists the largest “Old Economy” ICT companies by 2003 sales that were founded prior to 1955 or that, as in the cases of EDS and Comcast, combined with Old Economy firms at some point in their history. Half of the Old Economy companies are communications companies, with most having their roots in the old Bell System. Electronic Data Systems (EDS) would be a candidate for the New Economy list but for the fact that between 1984 and 1996 it was a division of General Motors; the automobile maker’s failure to integrate EDS into its organization was directly related to the conflicting organizational characteristics of OE and NEBM. Comcast became a major player in 2000-2001 by acquiring AT&T (formerly American Telephone & Telegraph) Broadband.

Comparing Tables 1 and 2, the 2003 revenues of the top 20 Old Economy (OE) firms were 59.7 percent of the revenues of all 99 ICT companies that made the *Fortune* 1000 list, while those of the top 20 New Economy (NE) firms were 26.6 percent; the ratio of the 2003 revenues of the top 20 OE firms to the top 20 NE firms was 2.2. The OE:NE employment ratio declined from 5.8 in 1996 to 2.4 in 2003, reflecting both the faster employment growth of NE firms in the boom and the contraction of employment at OE firms from 2000. The average revenues per employee of OE firms were only 91 percent of those of the NE firms, indicative of a greater concentration of many NE firms on higher value-added activities.

Into the early 1980s two companies—AT&T and IBM (International Business Machines)—dominated the U.S. ICT industries, AT&T in communications and IBM in information technology. While they were by no means the only important ICT companies in the Old Economy, the histories of AT&T and IBM exemplify the evolution of OE and the centrality of the “organization man” to that business model. At the same time, AT&T and IBM had very different employment relations, which in effect made them two distinct versions of OE with implications for the ways in which, during the 1990s, the two companies responded to the competitive challenge from NEBM. Let me, therefore, briefly summarize OE as it could be found at AT&T and IBM coming into the 1990s.

In 1881 American Bell Telephone, the successor to the Bell Telephone Company that had been founded four years earlier, secured a controlling interest in the Western Electric Manufacturing Company, itself founded in 1872, as its exclusive manufacturer of telephones in the United States. In

TABLE 1  
Employment, 1996-2003, at the Top 20 “Old Economy” Companies by 2003 Sales

In parenthesis: a) Year of founding (of parent company, where applicable); b) Rank in 2004 Fortune 500 list; c) State in which headquartered	Sales \$b		Employees				2003 Sales/ Employee
	2003	1996	2000	2001	2002	2003	
<b>“Old Economy” Companies</b>	<b>2003</b>	<b>1996</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	
IBM (1911; 9; NY)	89.1	240,615	316,309	319,876	315,889	319,273	\$279,072
Hewlett-Packard (1939; 11; CA)	73.1	112,000	88,500	86,200	141,000	142,000	\$514,789
Verizon Communications (1885; 12; NY)	67.6	62,600	260,000	247,000	229,500	203,100	\$332,841
SBC Communications (1885; 33; TX)	40.8	61,450	204,530	215,088	175,400	168,000	\$242,857
AT&T (1877; 40; NJ)	34.5	130,000	166,000	117,800	71,000	61,600	\$560,065
Motorola (1928; 61; IL)	27.1	139,000	147,000	111,000	97,000	88,000	\$307,955
Sprint (1899; 65; KS)	26.2	48,024	84,100	83,700	72,200	66,900	\$391,629
Bellsouth (1885; 80; GA)	22.6	81,200	103,900	87,875	77,000	76,000	\$297,368
Electronic Data Systems (1962; 87; TX)	21.6	100,000	122,000	143,000	137,000	132,000	\$163,636
Comcast (1963; 89; PA)	21.3	16,400	35,000	38,000	82,000	68,000	\$313,235
AT&T Wireless Services (1885; 120; WA)	16.7	na	29,000	33,000	31,000	31,000	\$538,710
Xerox (1906; 130; CT)	15.7	86,700	92,500	78,900	67,800	61,100	\$256,956
Qwest Communications (1885; 136; CO)	14.9	720	67,000	61,000	47,000	47,000	\$317,021
Texas Instruments (1930; 197; TX)	9.8	59,927	42,400	34,724	34,589	34,154	\$286,936
First Data (1871; 242; CO)	8.5	40,000	27,000	29,000	29,000	29,000	\$293,103
Lucent Technologies (1869; 243; NJ)	8.5	124,000	126,000	77,000	47,000	34,500	\$246,377
Alltel (1943; 251; AR)	8.2	16,307	27,257	23,955	25,348	19,986	\$410,287
Unisys (1873; 312; PA)	5.9	32,900	36,900	38,900	36,400	37,300	\$158,177
Cox Communications (1898; 318; GA)	5.8	7,200	19,000	20,700	21,600	22,150	\$261,851
NCR (1884; 322; OH)	5.6	38,600	32,960	30,445	29,700	29,000	\$193,103
<b>Averages (per firm)</b>	<b>26.2</b>	<b>73,560</b>	<b>101,368</b>	<b>93,858</b>	<b>88,371</b>	<b>83,503</b>	<b>\$318,298</b>

Source: *Fortune*, 5 April 2004, F32-F67; URL: <http://www.hoovers.com>.

TABLE 2  
Employment, 1996-2003, at the Top 20 "New Economy" Companies by  
2003 Sales

<b>In parenthesis: a) Year of founding; b) Rank in 2004 Fortune 500 list; c) State in which headquartered</b>	<b>Sales \$b</b>						
<b>New Economy Companies</b>	<b>2003</b>	<b>1996</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	
Dell Computer (1984; 31; TX)	41.4	8,400	36,500	40,000	34,600	39,100	\$1,196,532
Microsoft (1975; 46; WA)	32.2	20,561	39,100	47,600	50,500	55,000	\$637,624
Intel (1968; 53; CA)	30.1	48,500	86,100	83,400	78,700	79,700	\$382,465
Cisco Systems (1984; 100; CA)	18.9	8,782	34,000	38,000	36,000	34,000	\$525,000
Solectron (1977; 167; CA)	11.7	10,781	65,273	60,000	73,000	66,000	\$160,274
Sun Microsystems (1982; 173; CA)	11.4	17,400	38,900	43,700	39,400	36,100	\$289,340
Computer Sciences (1959; 175; CA)	11.3	33,850	58,000	68,000	67,000	90,000	\$168,657
Nextel Communications (1987; 183; VA)	10.8	3,600	19,500	17,000	14,900	17,000	\$724,832
Sanmina-SCI (1980; 188; CA)	10.4	1,726	24,000	48,774	46,030	45,008	\$225,940
Oracle (1977; 208; CA)	9.5	23,111	41,320	42,297	42,006	40,650	\$226,158
Science Applications Intl. (1969; 289; CA)	6.5	21,100	39,078	41,500	40,400	38,700	\$160,891
EMC (1979; 299; MA)	6.2	4,800	24,100	20,100	17,400	20,000	\$356,322
Apple Computer (1977; 307; CA)	6.2	10,896	8,568	9,603	10,211	10,912	\$607,188
EchoStar Communications (1993; 327; CO)	5.6	1,200	11,000	11,000	15,000	15,000	\$373,333
Charter Communications (1992; 358; MO)	4.8	2,000	13,505	17,900	18,600	15,500	\$258,065
Jabil Circuit (1966; 367; FL)	4.7	2,649	19,115	17,097	20,000	26,000	\$235,000
Applied Materials (1967; 392; CA)	4.5	11,403	19,220	17,365	16,077	12,050	\$279,903
Maxtor (1982; 423; CA)	4.1	8,940	8,551	9,811	12,449	13,554	\$329,344
Affiliated Computer Serv. (1988; 445; TX)	3.8	5,850	18,500	21,000	36,200	40,000	\$104,972
Gateway (1985; 484; CA)	3.4	9,700	24,600	14,000	11,500	7,407	\$295,652
<b>Averages (per firm)</b>	<b>11.9</b>	<b>12,762</b>	<b>31,447</b>	<b>33,407</b>	<b>33,999</b>	<b>35,084</b>	<b>\$349,279</b>

Source: *Fortune*, 5 April 2004, F32-F67; viewed. URL: <http://www.hoovers.com>.

1885, American Bell created AT&T as its subsidiary to build and operate the long-distance telephone network, and in an 1899 reorganization AT&T became the parent company of what had become known as the Bell System.

From the outset, salaried managers, not shareholders, ran the Bell System. The most important manager was Theodore Vail, who quit as the company's president in 1887, only to return as a board member of AT&T

from 1900 and as its CEO from 1907 to 1919.<sup>13</sup> When Vail re-entered the company, it was subject to intense competition, the Bell patents having expired in 1894. Vail's most lasting achievement was to transform the company into a regulated monopoly—a status AT&T assumed from 1913—that was committed to delivering interconnected telephone service to every locality in the United States, no matter how isolated.

Through Bell Telephone Laboratories, established in 1925 as a joint R&D subsidiary of AT&T and Western Electric, the Bell System used its regulated monopoly status to generate knowledge that would eventually change the face of ICT. In 1984, the monopoly came to an end as a result of a U.S. antitrust decree, after carriers such as MCI and Sprint had won the legal right to tap into the Bell System to deliver competitive long-distance service. The “breakup” of the Bell System separated the regional operating companies from AT&T as the long-distance carrier, while the wholly owned manufacturing subsidiary, Western Electric, became AT&T Technologies, an internal division of AT&T. In 1996, AT&T spun off AT&T Technologies into the independent telecommunications equipment company Lucent Technologies, which included Bell Labs within its corporate structure.

In 1947, John Bardeen, Walter Brattain, and William Shockley invented the transistor at Bell Labs, an achievement that was the foundation of solid-state electronics and for which the three men received the 1956 Nobel Prize in Physics. Bell Labs ran seminars on the transistor for U.S.-based companies in 1951 and for foreign companies, as well, in 1952, and then licensed the technology on terms that resulted in its rapid diffusion to ICT firms.<sup>14</sup> A U.S. government antitrust suit, launched in 1949, that had sought to sever the exclusive relation between AT&T and Western Electric resulted in a 1956 consent decree that allowed AT&T to maintain control over its manufacturing arm, but barred the company from competing in industries other than telecommunications. In addition, AT&T and Western had to license their patents to other companies at reasonable fees.<sup>15</sup> As a result, Bell Labs R&D supported the development of ICT, while the communications and computer industries remained organizationally distinct.

During the 1950s and 1960s, IBM came to dominate the computer industry to almost the same extent that AT&T dominated communications, even though IBM was not a regulated monopoly. IBM had its origins in the Hollerith punch-card tabulating machine invented and patented in 1884. Henry Hollerith gained fame through the highly

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<sup>13</sup> Louis Galambos, “Theodore N. Vail and the Role of Innovation in the Modern Bell System,” *Business History Review* 66 (Spring 1992): 95-126.

<sup>14</sup> Michael Riordan and Lillian Hoddeson, *Crystal Fire: The Invention of the Transistor and the Birth of the Information Age* (New York, 1997), chap. 10.

<sup>15</sup> Anthony Lewis, “A.T.&T. Settles Antitrust Case; Shares Patents,” *New York Times*, 25 Jan. 1956.

successful use of his machine for the 1890 U.S. Census.<sup>16</sup> In 1911, the Tabulator Machine Company, founded by Hollerith in 1896, was involved in a merger that resulted in the Computing-Tabulating-Recording Company (CTR), based in New York City with 1,300 employees. Thomas Watson, Sr., previously a salesman at National Cash Register, became president of CTR in 1915. Nine years later, when CTR built a major manufacturing facility in Europe, it changed its name to International Business Machines. IBM's main business was punch-card accounting machines. In 1935, it held 85 percent of the world market and gained the lucrative government contract for the U.S. Social Security Administration.<sup>17</sup> The company also profited from its operations in Europe, including those in Nazi Germany and Nazi-occupied territories.<sup>18</sup> In 1929, IBM had \$18 million in revenues and 5,999 employees. In 1939, the Great Depression notwithstanding, the company had \$38 million in revenues and 11,315 employees. Over the course of the 1930s, the company had profits of \$74 million on sales of \$240 million.<sup>19</sup>

In 1952 IBM introduced its first computer, and, under Thomas Watson, Jr., who took over the CEO position from his father in 1956, became the leader in the computer industry during the 1950s. By 1963, IBM's dominance was such that its U.S. revenues of \$1.244 billion from data-processing computers were well over eight times that of its nearest competitor, Sperry Rand (the result of the 1955 merger of Remington Rand and Sperry Corporation). Indeed, the eight companies that followed IBM had combined U.S. revenues of \$539 million, or only 43 percent of IBM's.<sup>20</sup> IBM grew from \$166 million in revenues in 1950 to \$1.8 billion in 1960, \$7.5 billion in 1970, and \$26.2 billion in 1980. Table 3 shows the extent to which IBM dominated the various sectors of the computer hardware industry in 1984, when the company had total worldwide revenues of \$46 billion, earnings of \$5.5 billion, and 394,930 employees (the following year IBM's employment would reach what turned out to be its all-time high of over 405,000 employees).<sup>21</sup>

Both AT&T and IBM were vertically integrated companies, controlling the manufacture of components, equipment, and assembly with R&D and marketing activities. In the case of AT&T, its manufacturing arm was its

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<sup>16</sup> See Edwin Black, *IBM and the Holocaust: The Strategic Alliance between Nazi Germany and America's Most Powerful Corporation* (New York, 2001), 25-31; and Alfred D. Chandler, Jr., *Inventing the Electronic Century: The Epic Story of the Consumer Electronic and Computer Industries* (New York, 2001), 87.

<sup>17</sup> URL: [http://www-03.ibm.com/ibm/history/history/decade\\_1930.html](http://www-03.ibm.com/ibm/history/history/decade_1930.html).

<sup>18</sup> Black, *IBM and the Holocaust*, 118-20.

<sup>19</sup> IBM highlights, 1885-1969, viewed online. URL: <http://www-03.ibm.com/ibm/history/documents/index.html>.

<sup>20</sup> Chandler, *Inventing the Electronic Century*, 86.

<sup>21</sup> IBM highlights, 1885-1969, 1970-1984, and 1985-1989. URL: <http://www-03.ibm.com/ibm/history/documents/index.html>.

wholly owned subsidiary, Western Electric, which produced exclusively for AT&T. With the breakup of the Bell System in 1984, there was no substantial change in the relation between AT&T and Western Electric, when the latter was, overnight, transformed into AT&T Technologies, an internal division of the parent company. Given their dominance of the product markets on which they focused, AT&T and IBM remained during the 1980s classic “Chandlerian” corporations.<sup>22</sup>

Like all major corporations in the Old Economy, both AT&T and IBM are listed on the NYSE.<sup>23</sup> An important role of the stock market for both companies has been the separation of ownership from control. The number of AT&T shareholders increased from 8,000 in 1901, when it first listed on the NYSE, to almost 250,000 some two decades later, and throughout most of the twentieth century the company was the most widely held stock in the United States.<sup>24</sup> IBM had 770 stockholders in 1914, the year before, as CTR, the company went public on the NYSE. From 1925 through the 1950s, IBM regularly issued stock dividends and also did frequent stock splits. In 1959, the company had almost 109,000 shareholders and ten years later over 549,000. Notwithstanding the fact that Thomas Watson, Sr., ruled IBM for over four decades and was able to hand over the leadership of the company to his son, he was not a founder of the company and never owned more than 5 percent of IBM's outstanding stock.<sup>25</sup>

Both AT&T and IBM paid regular cash dividends to their shareholders. Indeed, in Old Economy fashion, AT&T has paid dividends for every quarter of every year since the first quarter of 1893.<sup>26</sup> Like most Old Economy companies up until the 1990s, both AT&T and IBM awarded stock options almost exclusively to executive officers.<sup>27</sup>

Until the early 1990s, IBM was known as a company that offered “lifelong employment” to both managerial and production personnel, with a defined-contribution pension plan and company-funded health insurance during both employment and retirement. In 1934, IBM gave all of its 7,600 employees access to group life insurance with survivor benefits

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<sup>22</sup> Chandler, *The Visible Hand*; Chandler, *Scale and Scope*.

<sup>23</sup> In 1996, AT&T did the largest initial public offering (IPO) in U.S. history up to that time when it spun off Lucent Technologies as an independent company, issuing shares valued at \$3 billion. In 2000, AT&T once again did the largest IPO in U.S. history when it listed AT&T Wireless as a tracking stock, issuing \$10.3 billion in shares.

<sup>24</sup> J. Warren Stehman, *The Financial History of the American Telephone and Telegraph Company* (Boston, 1925), 201, 327.

<sup>25</sup> Thomas J. Watson, Jr., and Peter Petre, *Father, Son & Co.: My Life at IBM and Beyond* (New York, 1990), 267.

<sup>26</sup> URL: <http://www.att.com/ir/cgi/divhistory.cgi>.

<sup>27</sup> AT&T 1996 Proxy Statement, 37; IBM, 1996 10-K.

TABLE 3  
 Top Five Companies by Worldwide Sales in Computer Hardware Sectors, 1984  
 (\$ millions)

Sales rank	Mainframes		Minicomputers		Microcomputers		Peripherals	
	Firm	Sales	Firm	Sales	Firm	Sales	Firm	Sales
1	IBM	13,131	IBM	3,000	IBM	5,500	IBM	11,652
2	Fujitsu	1,536	DEC	1,527	Apple	1,747	DEC	2,500
3	Sperry Rand	1,451	Wang	971	Commodore	1,000	Burroughs	1,412
4	NEC	1,077	HP	950	Tandy	574	Control Data	1,314
5	Control Data	813	Data General	840	Sperry Rand	503	Xerox	1,180

Notes: DEC=Digital Equipment; HP=Hewlett-Packard.

Source: Alfred D. Chandler, Jr., *Inventing the Electronic Century: The Epic Story of the Consumer Electronic and Computer Industries* (New York, 2001), 118-19.

added in 1935, and two years later it was one of the first among major U.S. corporations to give employees paid vacations (in this case, six days per year). In 1952, when IBM employed almost 41,500 people, it was claimed that the company had not laid off an employee since 1921, and that it had never experienced a slowdown or strike.<sup>28</sup> In 1958, with almost 89,000 employees, IBM was the first major company to place all hourly workers on salary. During 1971 and 1972, IBM reduced its headcount from 269,292 to 262,152 by offering its employees with twenty-five years of service the option of early retirement, five years ahead of schedule, a program that was repeated in 1975 when 1,900 people took up the offer.<sup>29</sup>

The institution of lifelong employment at IBM met its demise in the early 1990s, as IBM cut its payroll from 373,816 at the end of 1990 to 219,839 at the end of 1994. At first the company downsized by means of voluntary retirement schemes, but by 1992, several months before Louis Gerstner's arrival from RJR Nabisco to take over as IBM's CEO, it was clear that the tradition of lifelong employment was no more.<sup>30</sup>

If a commitment to lifelong salaried employment for all personnel characterized IBM in the post-World War decades, a distinction between salaried managers and unionized workers characterized employment in the Bell System during this period. In 1971, AT&T employed 1,015,000 people, of whom about 700,000 were union members (500,000 Communications Workers of America, 150,000 International Brotherhood of Electrical Workers, and 50,000 independent unions).<sup>31</sup> In the same year, Western Electric employed another 207,000 people, almost 151,000 of whom were union members (65,000 Communication Workers of America [CWA], 71,500 International Brotherhood of Electrical Workers, and 14,400 other unions).<sup>32</sup> At the time, Bell Labs employed 17,000 scientists and engineers.<sup>33</sup>

The salaried employees at AT&T, Western Electric, and Bell Labs had virtual lifetime employment, and were fully pensionable after thirty years of service. Collective bargaining got hourly workers the same benefits, and then some. While AT&T and Western Electric were by no means strike free, labor-management relations benefited from the market power and

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<sup>28</sup> Joseph C. Potter, "Good 'Human Relations' Keep Employees Happy and put IBM at the Top of Its Field," *Wall Street Journal*, 11 Feb. 1953.

<sup>29</sup> *Wall Street Journal*, 1 Sept. 1971; 14 Jan. 1975; 14 April 1975.

<sup>30</sup> See *New York Times News Service*, 16 Dec. 1992; Laurie Hays, "Blue Period: Gerstner Is Struggling as He Tries to Change Ingrained IBM Culture," *Wall Street Journal*, 13 May 1994; Louis V. Gerstner, Jr., *Who Says Elephants Can't Dance?* (New York, 2002).

<sup>31</sup> *Wall Street Journal*, 15 July 1971.

<sup>32</sup> See *Wall Street Journal*, 1 May 1971; Stephen B. Adams and Orville R. Butler, *Manufacturing the Future: A History of Western Electric* (New York, 1999).

<sup>33</sup> Boyce Rensberger, "Where Science Grows Miracles," *New York Times*, 20 Feb. 1972.

financial stability of these companies. When workers were laid off in a slump, it was the practice to hire them back when economic conditions improved. As a regulated monopoly, AT&T could look to rate increases to fund rising wage costs.<sup>34</sup> In 1956, Western Electric instituted a plan to pay the tuition of any employee who engaged in undergraduate or graduate study on his or her own time.<sup>35</sup> In 1969, the CWA staged the first national strike against AT&T since 1947, winning a 20 percent pay increase over three years to offset rises in the cost of living and company payment of the full healthcare plan premium rather than only one-quarter as was previously the case. In 1971, 500,000 CWA members struck AT&T over the erosion of their wages by inflation and won for the first time a cost of living adjustment (COLA) and big city allowances.<sup>36</sup> In 1983, a 22-day CWA strike on the eve of the breakup of the Bell System—and hence the last time the union would be able to negotiate with the AT&T of old—successfully won better wages as well as improvements in employment security, the pension plan, and health insurance.<sup>37</sup> As was generally the case in union-management relations at major industrial corporations in this era, union members not only had good pay, but attractive health and pension benefits, and their jobs were protected by seniority.

### **Evolution of NEBM: Products and Processes**

During the late 1990s, employment at the New Economy firms listed in Table 2 expanded rapidly, and on average they have sustained their employment growth in the early 2000s. The top twenty companies in Table 2 are spread across the ICT industrial classifications that *Fortune* uses in compiling its annual lists of the largest U.S. corporations in terms of sales: three are in computer and data services, four in computer office equipment, two in computer software, one in networking, five in semiconductors and other electronic components, and three in telecommunications. Of the five in semiconductors and other electronic components, three are contract manufacturers, one is a semiconductor equipment company, and one is a semiconductor manufacturing company. That last one is Intel, whose growth from its founding in 1968 to dominance of the microprocessor market has been central to the evolution of NEBM.

Two of the founders of Intel, Robert Noyce and Gordon Moore, were among the eight scientists and engineers who, in September 1957, left Shockley Semiconductor Laboratories to form Fairchild Semiconductor as a manufacturer of diffused silicon transistors in a nearby location in Mountain View, California. Over the following decades, the interfirm mobility of talented people to found or join startups became the defining

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<sup>34</sup> See *New York Times*, 22 April 22 1952.

<sup>35</sup> See *New York Times*, 29 Nov. 1956.

<sup>36</sup> *Wall Street Journal*, 20 July 1971.

<sup>37</sup> URL: <http://local1051.tripod.com/history/hist1.htm>.

characteristic of the dynamic regional economy that Fairchild, inadvertently, helped to create. From 1959 through 1970, forty-two new semiconductor firms—twenty-one in 1968 and 1969 alone—were launched in the vicinity of Fairchild in what, as a result, became known by the beginning of the 1970s as Silicon Valley.<sup>38</sup> By 1985, the number of Silicon Valley semiconductor startups since the founding of Fairchild totaled 125. Of those 125 firms, 32 were founded by at least one person who had left employment at Fairchild for that purpose, while another 35 companies were offspring from these “Fairchildren” (especially from National Semiconductor, Intel, Signetics, and Synertek).<sup>39</sup> These semiconductor firms laid the foundation for NEBM.

There were three distinct waves of Silicon Valley semiconductor startups from 1959 through 1985. The first wave, from 1959 to 1964, consisted of ten semiconductor firms oriented toward military markets. It is plausible to contend that without U.S. Department of Defense spending on corporate research and contracts, the U.S. semiconductor industry would not have gotten off the ground. Between 1955 and 1963, while the value of total U.S. semiconductor production rose from \$40 million to \$610 million, the proportion for the U.S. military varied between 35 and 48 percent. In 1968, when the value of U.S. semiconductor production stood at \$1.159 billion, the value of military production was still 25 percent of the total. By that time, integrated circuits (ICs) accounted for 27 percent of the value of all U.S. semiconductor production, up from less than 3 percent five years earlier. Military demand was critical to the growth of this important sector, accounting for 94 percent of IC production in 1963 and 37 percent in 1968.<sup>40</sup>

Meanwhile, the price per IC declined from \$31.60 in 1963 to \$2.33 in 1968, thus dramatically increasing the economic viability of using ICs for cost-conscious civilian markets.<sup>41</sup> The realization of these commercial opportunities precipitated a second wave of Silicon Valley startups from 1968 through 1972, a period that saw forty startups, thirteen of which were “Fairchildren,” and another eight companies their offspring. Over half of the startups during this period, therefore, were direct and indirect Fairchild “spin-offs.”

Through the interfirm mobility of personnel, and notwithstanding frequent lawsuits for the infringement of intellectual property, the startups were able to develop new products without engaging in expensive and time-consuming research. Fairchild was important to the emergence of

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<sup>38</sup> The first public use of the term “Silicon Valley” is credited to the journalist Don C. Hoefler in a series of articles that he wrote for *Electronic News* in 1971.

<sup>39</sup> Silicon Valley Genealogy Chart, available from SEMI (Semiconductor Equipment and Materials International), <http://dom.semi.org>.

<sup>40</sup> John E. Tilton, *International Diffusion of Technology: The Case of Semiconductors* (Washington, D.C., 1971), 90-91.

<sup>41</sup> *Ibid.*

Silicon Valley precisely because, even as it drew people and knowledge from the established R&D labs of the electronic tube companies such as General Electric, Radio Corporation of America [RCA], Westinghouse, and Sylvania, it invested heavily in research, especially related to manufacturing processes for the mass production of diffused silicon transistors.<sup>42</sup> Fairchild in effect brought all this research to Silicon Valley and, largely supported by government contracts, developed the knowledge and the people who by the late 1960s could take advantage of the vast opportunities for using chips in commercial products. As Gordon Moore, who had been head of R&D at Fairchild when he left in 1968 to co-found Intel, wrote for a 1993 conference on the decline of corporate research laboratories in the United States:

The large, central research laboratories of the premier semiconductor firms probably have contributed more to the common good than to their corporations. . . . Why do spin-offs and the community at large tend to reap so much from large research organizations and the firms that own them so little? . . . Running with the ideas that big companies can only lope along with has come to be the acknowledged role of the spin-off or start-up. Note, however, that it is important to distinguish here between exploitation and creation. It is often said that start-ups are better at creating new things. They are not; they are better at *exploiting* them.<sup>43</sup>

When Moore, with Noyce, founded Intel to produce memory chips that could replace the magnetic coil memories then in use, they specifically declined to create a separate R&D lab and refused to accept government contracts for research.<sup>44</sup> The two other most successful Silicon Valley semiconductor companies that emerged out of the second wave were National Semiconductor and Advanced Micro Devices (AMD), companies whose founders, as in the case of Intel, came from high executive positions at Fairchild and adopted similar commercialization strategies. As late as 1984, National Semiconductor had greater revenues than Intel (\$1.263 billion versus \$1.201 billion), while AMD had settled on being largely a “second source” for Intel products.

The third wave of Silicon Valley semiconductor startups began in 1978, peaked in 1983, and continued to 1985. During those years, fifty-eight new firms appeared, of which seven were Fairchildren and another twenty-six were offspring. In contrast to the dynamic random access memory (DRAM) and erasable programmable read-only memory

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<sup>42</sup> Ibid., 4.

<sup>43</sup> Gordon E. Moore, “Some Personal Perspectives on Research in the Semiconductor Industry,” in *Engines of Innovation: US Industrial Research at the End of an Era*, ed. Richard S. Rosenbloom and William J. Spencer (Cambridge, Mass., 1996), 171.

<sup>44</sup> Ross Knox Bassett, *To the Digital Age: Research Labs, Start-Up Companies, and the Rise of MOS Technology* (Baltimore, Md., 2002), chap. 6.

(EPROM) chips that had underpinned the growth of the second-wave companies such as Intel, National, and AMD, third-wave firms such as VLSI Technology (1979), LSI Logic (1981), Cypress Semiconductors (1983), Cirrus Logic (1984), and Chips & Technologies (1985) focused on logic chips (microprocessors and application specific integrated circuits [ASICs]) for which value-added lay in chip design rather than high-yield, low-defect mass production. In pursuing this design-oriented strategy, the founders of these startups and their backers were taking advantage of the new commercial opportunities opened up by the growth of consumer and business electronic product markets. Meanwhile during this third wave, integrated Japanese producers such as NEC, Hitachi, Toshiba, and Fujitsu that sold only a portion of the memory chips they produced were taking command of the markets that second-wave companies such as Intel and National served.<sup>45</sup> By 1985 DRAMs and EPROMs had become known as “commodity chips,” mainly because of the formidable Japanese challenge based on superior manufacturing methods that resulted in fewer defects and higher yields.<sup>46</sup>

Around 1985 this Japanese challenge undermined the profitability of all the major memory producers, Intel included. So great was the Japanese threat in commodity chips that the most powerful U.S. semiconductor companies banded together to form SEMATECH, with partial funding from the U.S. government, in an attempt to ensure that the United States would not lose indigenous capability in the production of semiconductor fabrication equipment as well.<sup>47</sup> By the beginning of the 1990s, however, Intel re-emerged as the dominant U.S. competitor on the global semiconductor market, its revenues surpassing Texas Instrument’s beginning in 1990 and Motorola’s in 1991. The foundation of Intel’s success was the microprocessor, the revolutionary device that it had invented in 1971 and that became the major source of revenues for the company with the IBM-led Personal Computer (PC) revolution of the 1980s.

In 1981, IBM announced its PC, with the operating system supplied by Microsoft and the microprocessor by Intel. Both Microsoft and Intel

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<sup>45</sup> See William Pat Patterson, “Gathering Storm Clouds for Semiconductors,” *Industry Week*, 26 Jan. 1981; “It’s Semiconductors’ Turn to Fight the Japanese,” *ibid.*, 22 Feb. 1982; and Marilyn Chase, “The Chip Race,” *Wall Street Journal*, 4 Feb. 1983.

<sup>46</sup> See Daniel I. Okimoto and Yoshio Nishi, “R&D Organization in Japanese and American Semiconductor Firms,” in *The Japanese Firm: The Sources of Competitive Strength*, ed. Masahiko Aoki and Ronald Dore (New York, 1994), 178-208; Robert A. Burgelman, “Fading Memories: A Process Theory of Strategic Exit in Dynamic Environments,” *Administrative Science Quarterly* 39 (1994): 24-56.

<sup>47</sup> Larry D. Browning and Judy C. Shetler, *Sematech: Saving the U.S. Semiconductor Industry* (College Station, Texas, 2000).

retained the right to sell these products to other companies. In 1982, IBM accounted for almost 14 percent of Intel's revenues.<sup>48</sup> At the end of 1982, IBM paid \$250 million for a 12 percent equity interest in Intel that subsequently rose to 20 percent. The move was designed both to ensure that Intel had financing commensurate with IBM's reliance on the semiconductor company and to send a signal that, in competing in the PC industry that it was in the process of creating, IBM would support its suppliers.<sup>49</sup> The \$250 million infusion of cash was over nine times Intel's 1981 earnings and just \$10 million less than Intel's capital expenditures plus R&D spending for 1982.

Some observers saw the equity purchase as the first step toward IBM's taking control of Intel. While IBM did get one seat on Intel's board, it agreed not to get involved in Intel's day-to-day operations and not to increase its holdings of Intel stock beyond 30 percent. Moreover, as noted in a 1983 *Business Week* article, the exercise of direct control by established corporations over previously independent semiconductor companies might not yield the best results:

In 1978, Honeywell bought Synertek; a year later Schlumberger grabbed Fairchild Camera & Instrument, while United Technologies took Mostek. The trend appears to have crested in 1981, when Gould acquired American Microsystems and Westinghouse bought into Siliconix. But, notes [Intel president, Andrew] Grove, those linkups "are anything but wildly successful," so a new spirit of cooperation is emerging.<sup>50</sup>

Underpinning that new spirit of cooperation (including Intel's own growth) was the phenomenal success of the IBM PC in the first half of the 1980s. In 1982, its PC sales were \$500 million and just two years later eleven times that amount, more than triple the 1984 revenues of its nearest competitor, Apple, and about equal to the revenues of its top eight rivals. Subsequently, the very success of the IBM PC, combined with open access to the Microsoft operating system and Intel microprocessor, meant that in the last half of the 1980s and beyond IBM lost market share to PC clones such as Compaq, Gateway, and Dell.<sup>51</sup>

IBM's strategy for entering the microcomputer market had consolidated and reinforced the vertically specialized structure of the industry in line with what can be viewed as the Silicon Valley model.<sup>52</sup>

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<sup>48</sup> Chase, "The Chip Race."

<sup>49</sup> *Business Week*, 10 Jan. 1983; Randall Smith, "IBM's \$300 Million Sale of Eurobonds Is Seen as Move to Loosen Ties to Intel," *Wall Street Journal*, 10 Feb. 1986.

<sup>50</sup> *Business Week*, 10 Jan. 1983.

<sup>51</sup> Chandler, *Inventing the Electronic Century*, 118-99, 142-43.

<sup>52</sup> Andrew S. Grove, *Only the Paranoid Survive* (New York, 1996); Michael H. Best, *The New Competitive Advantage: The Renewal of American Industry* (New York, 2001), 124.

While defining the “open access” standards for the computer industry, the subsequent domination by Intel and Microsoft of the product markets for microprocessors and operating software, respectively, created an immense barrier to entry to actual and potential competitors who would directly confront the New Economy giants, while at the same time opening up countless opportunities for new entrants to develop specialized niche products that conformed to the “Wintel” architecture.<sup>53</sup>

For the major Silicon Valley semiconductor companies in the 1970s, vertical specialization in chips had been an outcome, not a strategic choice. As part of its strategy to integrate forward into consumer products, National Semiconductor and Fairchild started producing and marketing calculators.<sup>54</sup> In 1972, Intel acquired a Silicon Valley digital watchmaker, Microma, which pioneered in liquid crystal display watches. National Semiconductor and Fairchild Camera and Instruments (the parent company of Fairchild Semiconductor and by this time based in Silicon Valley) were also producing digital watches, as was Texas Instruments.<sup>55</sup> Indeed, price competition from its semiconductor rivals led Intel to exit the watch business in 1978, taking a loss of \$15 million on the venture.<sup>56</sup>

As Charles Sporck of National Semiconductor was to recognize in 1979: “The gap between our basic business and the consumer business was enormous. The semiconductor industry is a professional price/performance business, while consumer is only distantly related to that concept. This was something the semiconductor industry didn’t understand.”<sup>57</sup> Capital goods were, however, another matter. During the 1970s, National manufactured checkout scanners, and made money in that business before being out-competed by IBM and NCR.<sup>58</sup> In the same 1979 *New York Times* article that quoted Sporck on consumer goods, the journalist stated: “It is almost axiomatic in the electronics industry that companies in the semiconductor business want to go into end-user businesses, in other words to vertically integrate into finished products and systems.”<sup>59</sup> Titled “To Clone a Computer,” the article described how National, following the lead of Silicon Valley-based Amdahl, had successfully entered the plug-compatible mainframe (PCM) market, producing clones of IBM’s

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<sup>53</sup> Michael Borrus and John Zysman, “Wintelism and the Changing Terms of Global Competition: Prototype of the Future?” BRIE Working Paper 96B, Feb. 1997.

<sup>54</sup> Charles Sporck, *Spinoff: A Personal History of the Industry That Changed the World* (Saranac Lake, NY, 2001), 228-30.

<sup>55</sup> See *Business Week*, 19 April 1976.

<sup>56</sup> John Wharton, “Top 10 List: Intel’s Technological Detours En Route to Success,” *InfoWorld*, 9 April 1990; *Computerworld*, 1 July 1996; David Manners, “Hero of our time,” *Electronics Weekly*, 26 March 1997; Sporck, *Spinoff*, 185-87.

<sup>57</sup> Peter J. Schuyten, “To Clone a Computer: Neophyte National Semiconductor Has Jolted the Industry,” *New York Times*, 4 Feb. 1979.

<sup>58</sup> Sporck, *Spinoff*, 230-31.

<sup>59</sup> Schuyten, “To Clone a Computer.”

machines. By the early 1980s, however, Hitachi manufactured all of National's PCMs, and in 1989, Hitachi and Electronic Data Systems bought National's mainframe business.<sup>60</sup>

In addition, leading Silicon Valley semiconductor companies, including Intel, National, and Intel spin-off Zilog, entered the minicomputer industry in the late 1970s and early 1980s, but were out-competed by not only the Japanese, but also Route 128 firms such as Digital Equipment Corporation (DEC) and Data General as well as IBM and Hewlett-Packard. In 1981, Intel entered the microcomputer industry, one in which National was already engaged using Intel's 8086 microprocessor. Intel's director of corporate planning, Les Vadasz, argued that Intel's forward integration into microcomputers was strategic: "We develop products because they fit into our overall architecture of things."<sup>61</sup> However, 1981 was also the year that IBM launched its personal computer, using Intel's microprocessor. IBM's success pushed Intel out of the microcomputer business, and helped to ensure that the leading producer of microprocessors would grow to world dominance as a specialized semiconductor company.

The Silicon Valley semiconductor companies, therefore, had tried to integrate forward into final products, but competition from integrated Japanese and U.S. rivals forced them to specialize in chips. Vertical specialization, however, did not stop there. A number of Silicon Valley design-oriented chip companies that entered the industry in the 1980s, and even more so in the 1990s, did so without investing in the manufacture of semiconductors. The pioneer in fabless chip design was LSI Logic. Wilf Corrigan, former CEO of Fairchild, launched LSI Logic in 1981 with \$6 million and military orders, and with all production outsourced. By 1983, however, the complexity of the ASICs that LSI was designing compelled the company to integrate backward into manufacturing, opening its first plant in 1983 in Santa Clara, California. As the company grew, it expanded its manufacturing capacity.<sup>62</sup> Nevertheless, from the last half of the 1980s, as the demand for ASICs grew, many producers of programmable logic devices and graphics processors such as Altera, NVIDIA, and Xilinx turned to foundries to manufacture their chips. The Taiwanese in particular took advantage of the opportunity, as Taiwan Semiconductor Manufacturing Company (TSMC) and United Microelectronics Corporation (UMC) became the largest semiconductor contract manufacturers in the world. In the 2000s even IBM has entered the foundry business, with its Microelectronics division generating \$2 billion

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<sup>60</sup> *Business Week*, 21 Feb. 1983; Chuck Molloy, "Hitachi, Ltd. and Electronic Data Systems form Hitachi Data Systems," *Business Wire*, 1 May 1989.

<sup>61</sup> *Business Week*, 16 Nov. 1981.

<sup>62</sup> Bryce G. Hoffman, "Fremont, Calif.-Based Microchip Maker Has Become One of Hottest Stocks," *Knight-Ridder Business Tribune News*, 23 July 1999.

in revenues in 2003 by manufacturing chips for other semiconductor firms.<sup>63</sup>

If a layer of vertical specialization has emerged in the manufacture of chips, so too has it emerged in the assembly of chip sets, printed circuit boards, and, increasingly, even finished products.<sup>64</sup> In the 1980s and early 1990s contract manufacturers (CMs) operated as job shops that took on extra work from integrated original equipment manufacturers (OEMs) in periods of peak demand. Then during the mid-1990s a few Old Economy companies—in particular IBM, Hewlett-Packard, and Ericsson—took the lead in selling existing plants to CMs. Meanwhile the newest New Economy companies engaged in internetworking such as Cisco and 3Com outsourced all of their manufacturing from the outset.

In the Internet boom of the late 1990s, the demand for CM capacity soared. New Economy companies that did no manufacturing relied on CMs not only for assembly, but also for an increasing array of services including testing, design, documentation, and shipping.<sup>65</sup> Old Economy telecommunications equipment companies such as Motorola, Lucent, Nortel, and Alcatel also undertook major outsourcing programs to CMs; by 2000, there was a rush by these companies to offload manufacturing plants. Growth and consolidation among CMs that could offer the requisite scale and range of services resulted in the emergence of five dominant firms: Celestica, Flextronics, Jabil Circuit, Solectron, and Sanmina-SCI.<sup>66</sup> From 1993 to 2003, the largest CM, Flextronics, increased its revenues from \$93 million to \$13.4 billion and its employment from 2,000 to 95,000, while the second largest CM, Solectron, increased its revenues from \$836 million to \$11.0 billion and its employment from 4,500 to 66,000.<sup>67</sup>

### Evolution of NEBM: Capital

Funding the entry of firms into these specialized layers of ICT industries were technology-oriented venture capital firms that by the 1980s had

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<sup>63</sup> See Hoover's website: <http://www.hoovers.com>; Blaise Zerega, "Real Men Hire Fabs: Chip Companies Are Cutting Costs by Outsourcing," *Red Herring*, 1 March 1999; Jay Shelton, "The Global Fabless Model," PowerPoint presentation, Fabless Semiconductor Association (FSA), 2004.

<sup>64</sup> Timothy J. Sturgeon, "Modular Production Networks: A New American Model of Industrial Organization," *Industrial and Corporate Change* 11 (June 2002): 451-96.

<sup>65</sup> Lawrence J. Curran, "An Expanding Universe (Growth of Electronics Contract Manufacturers)," *Electronic Business Today* (1 Aug. 1997).

<sup>66</sup> James Carbone, "Growth Means More Consolidation, More Services," *Purchasing*, 19 Oct. 2000; James Carbone, "Electronics Outsourcing: Design Moves Into EMS Spotlight," *ibid.*, 17 Jan. 2002; James Carbone, "Targeting Design," *ibid.*, 21 Oct. 2004.

<sup>67</sup> See Hoover's website: <http://www.hoovers.com>.

become integral to both Silicon Valley and NEBM. These firms were organized as general partnerships of venture capitalists who raised funds, largely from institutional investors such as pension funds, universities, and banks; reviewed and selected the particular portfolio of industrial ventures in which to invest; maintained control over resource allocation to these ventures, including the staging of funding as the venture evolved; maintained control over resource allocation by these ventures, including the hiring and firing of executive personnel; and sought to realize returns to the venture capital fund through either an initial public offering (IPO) of the stock of the venture-backed industrial firms or a private sale of those firms to already established corporations. It was Silicon Valley practice, which by the 1980s became the standard for U.S. venture capital, for the general partners of the venture capital firm to receive a “carried interest” of at least 20 percent of the returns of a particular venture capital fund that they raised, distributing the remainder to the institutions or individuals who, as limited partners, provided the general partners with the capital for the fund.<sup>68</sup>

Although Silicon Valley had become the epicenter of venture capital in the United States by the 1980s, both the concept and the practice of venture capital were of East Coast origin. In the late 1930s, established industrial leaders argued that, by funding innovative new companies, “venture capital” could help deliver the U.S. economy from an economy that had failed to recover from depression.<sup>69</sup> While the unemployment rate in the U.S. economy never fell below 14.9 percent over the course of the 1930s, the decade was nevertheless an important one for the development of the research capabilities of Old Economy industrial corporations. The number of scientists and research engineers in the research labs of American companies increased from 6,320 in 1927 to 10,927 in 1933, a year in which the unemployment rate for the economy as a whole peaked at 25 percent. Notwithstanding the persistence of depressed economic conditions, in 1940 the number of research personnel had climbed to 27,777, over two and half times the number just seven years earlier. The war effort, which (rather than entrepreneurship) did succeed in finally getting the U.S. economy out of depression, helped to increase that number to 45,941 in 1946.<sup>70</sup> By the end of World War II, there was an immense accumulation of technological knowledge waiting to be commercialized.

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<sup>68</sup> See William A. Sahlman, “The Structure and Governance of Venture Capital Organizations,” *Journal of Financial Economics*, 27 (Oct. 1990): 473-521.

<sup>69</sup> See *Wall Street Journal*, 13 Jan. 1938; *Wall Street Journal*, 4 Feb. 1939, Hsu and Kenney, “Organizing Venture Capital.”

<sup>70</sup> These employment levels translated into ratios of research personnel per 1,000 wage earners of 0.83 in 1927, 1.93 in 1933, 3.67 in 1940, and 3.98 in 1946; see David C. Mowery and Nathan Rosenberg, *Technology and the Pursuit of Economic Growth* (New York, 1989), 64-71.

The U.S. system of higher education had played an important role in industrial research from the late nineteenth century on.<sup>71</sup> During the first decades of the twentieth century, the Massachusetts Institute of Technology (MIT) became the nation's most important academic institution for high-technology research and teaching.<sup>72</sup> In 1946, Karl Compton, the president of MIT, presided over the creation of American Research & Development (ARD), the first formal venture capital organization.<sup>73</sup> Along with Compton, Harvard Business School professor Georges Doriot, another one of ARD's prime movers, had been involved in pre-World War II discussions of the potential for venture capital to reinvigorate the New England economy. The expressed purpose of ARD was to support entrepreneurs in the founding of new firms in order to commercialize the accumulation of advanced scientific and technological capability that, as a result of military spending, MIT in particular had accumulated through World War II.

In the post-World War II decades, both MIT and ARD played important roles in the growth of the Route 128 high-tech corridor to the north and west of Boston.<sup>74</sup> In the aftermath of World War II, Frederick Terman, dean of Stanford's School of Engineering was seeking to implement a similar vision of a high-tech industrial district, anchored by a major research university, in the area surrounding Stanford's location in Palo Alto, California.<sup>75</sup> During the late 1940s and 1950s, in the context of Cold War military spending, many startups were spun off from Stanford and many established industrial corporations set up operations in the area, transforming Palo Alto and its environs into a major center for

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<sup>71</sup> See Louis Ferleger and William Lazonick, "The Managerial Revolution and the Developmental State: The Case of U.S. Agriculture," *Business and Economic History* 22 (Winter 1993): 67-98; Nathan Rosenberg and Richard Nelson, "American Universities and Technical Advance in Industry," *Research Policy* 23, no. 3 (1994): 323-48.

<sup>72</sup> David Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (New York, 1977).

<sup>73</sup> Hsu and Kenney "Organizing Venture Capital," 9-10.

<sup>74</sup> See Susan Rosegrant and David R. Lampe, *Route 128: Lessons from Boston's High-Tech Community* (New York, 1992), chaps. 2-4; Hsu and Kenney "Organizing Venture Capital."

<sup>75</sup> Stuart W. Leslie, "How the West Was Won: The Military and the Making of Silicon Valley," in *Technological Competitiveness: Contemporary and Historical Perspectives on the Electrical, Electronics, and Computer Industries*, ed. William Aspray (New York, 1993), 75-89; AnnaLee Saxenian, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, Mass., 1994); Stuart W. Leslie and Robert H. Kargon, "Selling Silicon Valley: Frederick Terman's Model for Regional Advantage," *Business History Review* 70 (Winter 1996): 435-72; Leslie Berlin, "Robert Noyce and Fairchild Semiconductor, 1957-1968," *Business History Review* 75 (Spring 2001): 63-102.

microwave and aerospace technology.<sup>76</sup> Semiconductors came to the region in 1955 when, after an aborted attempt by William Shockley to work with Raytheon (a leading military contractor in the Boston area with close ties to MIT), he secured the backing of Los Angeles–based Beckman Instruments to set up shop close to Stanford.

In 1957, a little more than a year after being hired by Shockley, eight scientists and engineers—Julius Blank, Victor Grinich, Jean Hoerni, Eugene Kleiner, Jay Last, Gordon Moore, Robert Noyce, and Sheldon Roberts—left Shockley Labs in search of funding from “a corporation interested in getting into the advanced semiconductor device business” in the lower San Francisco Peninsula.<sup>77</sup> In 1957, there were some individuals involved in venture finance working for certain San Francisco financial institutions, most notably Reid Dennis of the Fireman’s Fund and an informal circle of friends he called “The Group.”<sup>78</sup> There were, however, no firms on the West Coast specifically organized to provide venture capital.<sup>79</sup>

In a stroke of good fortune, a letter that Eugene Kleiner wrote to his father’s broker at the New York investment bank, Hayden Stone, inquiring about where the “well-trained technical group” of Shockley defectors might get funding that “could get a company into the semiconductor business within three months,” came to the attention of Arthur Rock, a young Hayden Stone employee with a Harvard MBA. Rock had already been involved in the venture financing, IPO, and then sale of an East Coast semiconductor company, General Transistor.<sup>80</sup> Rock quickly responded,

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<sup>76</sup> Leslie, “How the West Was Won.”

<sup>77</sup> Letter from Eugene Kleiner to Hayden Stone, quoted in Christophe Lécuyer, “Fairchild Semiconductor and Its Influence,” in *The Silicon Valley Edge: A Habitat for Innovation and Entrepreneurship*, ed. Chong-Moon Lee et al. (Stanford, Calif., 2000), 158-83, quotation at p. 163.

<sup>78</sup> Reid Dennis, “Institutional Venture Partners,” in *Done Deals: Venture Capitalists Tell their Stories*, ed. Udayan Gupta (Boston, Mass., 2000), 179-90; see esp. pp. 182-83.

<sup>79</sup> The first firm in the region devoted to venture capital, Draper, Gaither, and Anderson, would be started a year later. In 1957, Georges Doriot and his Boston-based venture-capital firm American Research & Development backed the founding of Digital Equipment Corporation, taking 78 percent of the ownership for a \$70,000 investment; see Wilson, *The New Venturers*, 19. When the “Traitorous Eight” (as Shockley dubbed them) did get funding to start Fairchild Semiconductor, Fairchild Camera’s investment was \$1.38 million. It is therefore unlikely that, even if the Eight had been willing to relocate to Route 128, they would have been able to raise that kind of money through ARD.

<sup>80</sup> See Arthur Rock, “Arthur Rock & Co.,” in *Done Deals*, ed. Gupta, 139-48, quotation at p. 141: “The reason I got so excited about Fairchild Semiconductor was because I’d already been in the semiconductor business through General Transistor.” See also Lécuyer, “Fairchild Semiconductor and Its Influence,” 163-64.

and after considerable time and effort, convinced the Long Island, New York, firm, Fairchild Camera and Instrument, to fund Fairchild Semiconductor. The eight Shockley defectors each received a 7.5 percent equity stake in Fairchild Semiconductor, with Hayden Stone holding 17 percent and the other 23 percent reserved for allocation in hiring new managers. The deal was structured so that, at its option, Fairchild Camera could buy out the shareholders for \$3 million dollars at any time before the company had three successive years of net earnings greater than \$300,000, or for \$5 million if the option was exercised within three to eight years.<sup>81</sup>

Fairchild Semiconductor experienced almost immediate success. In early 1958, the new enterprise landed a subcontract with IBM for semiconductors for the Minuteman missile. In 1958, Hoerni drew on Bell Labs research to perfect the planar process for the manufacture of silicon chips. Building on this breakthrough, the following year Noyce invented the integrated circuit.<sup>82</sup> In two years, the semiconductor company had grown from 13 to 700 employees and was highly profitable.<sup>83</sup> Its revenues for its second year through September 1959 were \$6.5 million, 80 percent of which were military sales.<sup>84</sup> In October 1959, just two years after the launch of Fairchild Semiconductor, Fairchild Camera exercised its option to buy back the company for \$3 million. The eight scientists and engineers who had founded Fairchild Semiconductor received publicly traded shares of Fairchild Camera and became employees of the company—now a division of the East Coast parent—that they once had owned.<sup>85</sup>

As for Arthur Rock, he was by no means finished with West Coast semiconductor startups or with the eight Fairchild Semiconductor founders. In 1960, while still a Hayden Stone employee, Rock arranged financing for two former executives of the West Coast conglomerate Litton Industries to launch Teledyne, a Los Angeles-based electronics firm. Rock remained actively involved in Teledyne's affairs, and in 1961 Hoerni, Kleiner, Last, and Roberts left Fairchild Semiconductor to found Amelco as a semiconductor division of Teledyne. In the same year Rock left Hayden Stone and relocated to the San Francisco area, where he quickly teamed up with Tommy Davis, a local financier with a legal background

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<sup>81</sup> Berlin, "Robert Noyce and Fairchild Semiconductor," 76; Lécuyer, "Fairchild Semiconductor and Its Influence," 166.

<sup>82</sup> Berlin, "Robert Noyce and Fairchild Semiconductor," 64.

<sup>83</sup> In announcing that his company would exchange Fairchild Camera shares for all of the Fairchild Semiconductor shares, president John Carter said the expansion of Fairchild Semiconductor's sales and profits would allow the company to grow without additional equity financing; see *Wall Street Journal*, 9 Oct. 1959, p. 20.

<sup>84</sup> Berlin, "Robert Noyce and Fairchild Semiconductor," 81; *Wall Street Journal*, 9 Oct. 1959, p. 20.

<sup>85</sup> *Wall Street Journal*, 9 Oct. 1959, p. 20.

and links with Stanford's Terman, to establish a venture capital firm, Davis and Rock. As general partners, Davis and Rock received a carried interest of 20 percent of the returns of the venture fund.<sup>86</sup> Among the limited partners of Davis and Rock were the eight Fairchild Semiconductor founders. When two of them, Moore and Noyce, decided to leave Fairchild in 1968 to found their own company, Intel, they turned to Rock for financing, and within days he had raised \$2.5 million.<sup>87</sup>

Rock was, therefore, a leading venture capitalist in both the first and second waves of Silicon Valley semiconductor startups. There was a co-evolution between the venture-capital firm entrants in the Silicon Valley region and semiconductor startups. As with the founding of semiconductor firms, the pattern of venture capital firm entrants exhibits three waves of growing amplitude, the first around 1958-1962, the second around 1968-1972, and the third around 1978-1983. With the exception of Rock, there was little involvement of San Francisco Peninsula venture capital with semiconductor startups until the second wave. That involvement picked up slowly in the middle of the second wave, and toward the end of the period, the semiconductor industry began contributing some of its well-known executives to the venture capital industry. In 1972, Donald Valentine, an engineer who had been head of marketing at Fairchild before joining National Semiconductor in 1967, founded Sequoia Capital, which became one of Silicon Valley's most successful venture capital firms. In addition, in 1972 Eugene Kleiner joined with Hewlett-Packard executive Thomas Perkins to found a venture capital firm that, as Kleiner Perkins Caufield & Byers, is commonly considered to be the exemplar of Silicon Valley venture capital. In 1972, Kleiner Perkins located its offices in a still largely vacant new complex at 3000 Sand Hill Road in Menlo Park, adjacent to Stanford and with easy

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<sup>86</sup> The prime advantage of a limited partnership as an organizational form was that the general partners, who as the active venture capitalists performed the critical roles of selecting, monitoring, and exiting the portfolio of new ventures, were able to share in the gains of the venture fund by means of both the carried interest and investments made on their own account. Under the Investment Company Act of 1940, the active venture capitalists in a venture capital firm that raised its funds through public share issues, as was the case with ARD, were prohibited from receiving a share of the profits or taking their own equity positions. It was argued that, lacking such arrangements for venture capitalists to gain from venture capital, it was difficult to employ people who would have the incentives and abilities to make the types of inherently uncertain decisions and exert the level of necessarily intense effort that venture investing demanded. See Hsu and Kenney, "Organizing Venture Capital," 33. During the 1960s the limited partnership arrangement became the norm in Silicon Valley, and subsequently for independent (non-corporate) venture capital firms throughout the United States as a whole (Sahlman, "Structure and Governance," 1990).

<sup>87</sup> Wilson *The New Venturers*, 38; Anthony Perkins, "Venture pioneers," *Red Herring*, 1 Feb. 1994.

access to the San Jose and San Francisco airports.<sup>88</sup> Sequoia also located there, as did many other Silicon Valley venture capital firms. So, too, did the Western Association of Venture Capitalists, the trade association that had been founded in 1967 and out of which grew the National Venture Capital Association (NVCA), started in 1973. The second wave of semiconductor startups, therefore, not only gave Silicon Valley its name, but also laid the foundation for an organized venture capital industry.

It was the innovative capabilities of the companies in which venture capitalists invested that created the value from which money could be made. By the 1970s, the semiconductor revolution had laid the technological foundation for a multiplying range of business and household product applications, and, coming out of the semiconductor revolution, the Silicon Valley venture capitalists had become part of the regional institutional environment. What was needed now was an adequate supply of capital for the investments in new ventures that could take advantage of the plethora of technological and market opportunities. Over the course of the 1970s, a number of changes in U.S. financial institutions encouraged the flow of capital into venture capital funds, thus favoring the growth of Silicon Valley and NEBM.

The launching of NASDAQ in 1971 made it much easier for a young company to go public, thus enhancing the ability of venture capitalists to use this mode of exit from their investments. In that year, for example, less than three years after being founded, Intel did its IPO on NASDAQ, with a loss before extraordinary items of \$513,000, offset by a gain of \$1,427,000 for “sale of manufacturing know-how,” for a net income of \$914,000.<sup>89</sup> Thirteen of the twenty New Economy firms in Table 2 are listed on NASDAQ, including Applied Materials (IPO in 1972), Apple Computer (1980), Microsoft (1986), Sun Microsystems (1986), Oracle (1986), Dell Computer (1988), and Cisco Systems (1990).

In 1975, the Securities and Exchange Commission (SEC) barred stock exchanges from charging fixed commissions on stock-trading transactions, ending a practice that had prevailed on Wall Street since 1796.<sup>90</sup> The change made it less costly for portfolio investors to move in and out of stock to realize capital gains as an alternative to holding stock for the sake of dividends. This type of investment behavior facilitated both an early IPO (because the public was often willing to absorb a new share issue of a firm without a record of profitability) and the subsequent growth of the firm (because the companies could forego paying dividends, using the funds instead for internal investment).

In 1978, in response to intensive lobbying led by the American Electronics Association (itself dominated by Silicon Valley), the U.S. Congress reduced the capital gains tax from 49 percent to 28 percent, thus

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<sup>88</sup> Randall Lane, “Venture Capital Heaven,” *Forbes* (18 July 1994).

<sup>89</sup> Intel 1972 *Annual Report*.

<sup>90</sup> *Wall Street Journal*, 25 Oct. 1974, p. 4.

reversing a 36-year trend toward higher capital gains taxes.<sup>91</sup> Venture capitalists saw lower capital gains taxes as encouraging both entrepreneurial investment in new companies and portfolio investment by individuals in the publicly traded stocks of young, potentially high-growth companies.

During the 1970s, however, venture capitalists still faced constraints on the amount of money that they could raise for venture funds, mainly because they could not gain access to the vast accumulation of household savings held by pension funds. That constraint was transformed almost overnight when on July 23, 1979, the U.S. Department of Labor clarified restrictions on the portfolios of pension funds imposed by the “prudent man” rule of the Employee Retirement Income Security Act (ERISA) of 1974.<sup>92</sup> The lackluster performance of the stock market in the early 1970s had combined with inflation to create a massive underfunding of defined-benefit corporate pension funds. ERISA, which a *Business Week* editorial described as “one of the most complex pieces of legislation ever passed by Congress,” made corporations responsible for under-funded pensions while at the same time making pension fund managers personally liable for breaches of their fiduciary duty to use the “prudent man” rule when making investments.<sup>93</sup> Under these circumstances, pension fund managers, who controlled the allocation of an ever-increasing share of U.S. household savings, avoided investment in venture capital funds. In July 1979, the Department of Labor decreed that pension fund money could be invested not only in listed stocks and high-grade bonds, but also in more speculative assets, including new ventures, without transgressing the prudent man rule.<sup>94</sup>

As a result, pension fund money poured into venture capital funds. Funds raised (in 1997 dollars) by independent venture partnerships (the type that prevailed in Silicon Valley) from pension funds were \$69 million in 1978 (15 percent of all funds raised), \$160 million in 1979 (31 percent), \$400 million in 1980 (30 percent), and \$421 million in 1981 (23 percent). By 1983, pension fund investment in independent venture partnerships had reached \$1.808 billion in 1997 dollars, of which private pension funds alone accounted for \$1.516 billion and public pensions \$292 million. Throughout the 1980s and 1990s pension funds provided from 31 to 59 percent of the funds raised by independent venture capital partnerships,

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<sup>91</sup> John Pierson, “Trend of Higher Levies on Capital Gains Is Reversed as President Signs Tax Bill,” *Wall Street Journal*, 9 Nov. 1978; *Business Week* (18 May 1981).

<sup>92</sup> See Powell Niland, “Reforming Private Pension Plan Administration,” *Business Horizons* (Feb. 1976), 25-35.

<sup>93</sup> *Business Week* (12 Jan. 1976).

<sup>94</sup> *Business Week* (13 Aug. 1979).

which in turn increased their share of all venture funds raised from 40 percent in 1980 to 80 percent a decade later.<sup>95</sup>

The massive infusion of capital into venture funds from the pension savings of U.S. households underpinned the third wave of entry of Silicon Valley venture capital firms. These venture capitalists in turn became much more active than previously in funding semiconductor startups, as well as those companies producing the array of electronic products that silicon chips made possible. Semiconductor firms were supplying microprocessors and ASICs to a growing range of computer applications, which created a multitude of new opportunities in computer hardware and software that venture capitalists could fund, from videogames and disk drives in the early 1980s to e-commerce and optical networking gear in the late 1990s. Apple Computer's highly successful IPO in December 1980 is generally credited with setting off the startup and IPO boom of the early 1980s. After achieving spectacular returns on its investments, averaging about 35 percent, between 1978 and 1983, the venture capital industry was punished for over-investing, with returns averaging less than 10 percent in the last half of the 1980s. After 1990, returns moved up once again, soaring to almost 150 percent at the peak of the dotcom boom of 2000 before turning negative in the not-unrelated crash of 2001 and 2002.<sup>96</sup>

The Silicon Valley venture capital model spread to other parts of the United States, especially during the 1990s, with investments being made in many different locations and in a wide range of industries. The main geographic center of U.S. venture capital, however, has continued to be California, with Silicon Valley remaining by far the most important location.<sup>97</sup> Over time there have been shifts in the leading sectors for venture financing.<sup>98</sup> Office and computer machinery was the leading sector from the last half of the 1960s through the first half of the 1980s, before being barely surpassed by the communications and electronics sectors in the last half of that decade. In the first half of the 1990s, biotech became important. Subsequently, from 1995 through 2002, ICT accounted for 57 percent of the value of all venture capital investments, of which more than four-fifths were in software, telecommunications, and networking.<sup>99</sup>

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<sup>95</sup> Paul Gompers and Josh Lerner, *The Venture Capital Cycle* (Cambridge, Mass., 2002), 8.

<sup>96</sup> Josh Lerner, "Boom and Bust in the Venture Capital Industry and the Impact on Innovation," *Economic Review*, Federal Reserve Bank of Atlanta (Fourth Quarter 2002), 25-39.

<sup>97</sup> Gompers and Lerner, *The Venture Capital Cycle*, 14; Milford B. Green, "Venture Capital Investment in the United States, 1995-2002," *The Industrial Geographer* 2 (2004): 2-30.

<sup>98</sup> Gompers and Lerner, *The Venture Capital Cycle*, 12-13; Green, "Venture Capital Investment in the United States."

<sup>99</sup> Green, "Venture Capital Investment in the United States."

The importance of telecommunications and networking as venture capital recipients in the 1990s and beyond reflects the evolution of converged information and communication technologies out of what, prior to networking, had been merely information technologies. The origins of this convergence go back to the early 1970s when, at Xerox PARC, the Palo Alto-based research arm of the Old Economy copier company, Robert Metcalfe led a team that developed Ethernet, a technology that enabled computers to communicate with one another.<sup>100</sup> When Xerox declined to commercialize the technology, Metcalfe sought to do so by co-founding 3Com (standing for “computer, communication, and compatibility”) in 1979. With the widespread adoption of the IBM PC from 1982, 3Com was well positioned to be a leader in providing the hardware and software for local area networks (LANs).

After 3Com acquired another Silicon Valley company, Bridge Communications, in 1987, it became the largest supplier of LAN equipment, followed by Novell (based in Provo, Utah).<sup>101</sup> By this time, however, business, government, and non-profit organizations that had installed LANs in geographically dispersed locations wanted bridges or routers that would link their LANs into wide area networks (WAN). The company that by the beginning of the 1990s was most successful in developing this internetworking technology was Cisco Systems.

In 1984, the husband-and-wife team Leonard Bosack and Sandy Lerner founded Cisco and initially ran it from their living room.<sup>102</sup> While working in computing in different parts of Stanford University, Bosack and Lerner were involved in the development of the university’s LANs and then took up the challenge of internetworking them. At the end of 1987, Cisco received an infusion of \$2.5 million in venture funds from Sequoia Capital.<sup>103</sup> Yet, with \$10 million in revenues in the 1987-88 fiscal year, venture finance was probably the least important of Sequoia’s contributions to the growth of the firm. The case of Cisco exemplifies the non-financial role of Silicon Valley venture capitalists in developing a promising startup into a going concern. The Sequoia partner most actively involved with the young company was Donald Valentine, who became a

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<sup>100</sup> Michael A. Hiltzik, *Dealers of Lightning: Xerox PARC and the Dawn of the Computer Age* (New York, 1999), chap. 13.

<sup>101</sup> John T. Mulqueen, “Industry Watch: The Data Communications 100: A Year of Waiting for Another to Begin So Something Significant Could Happen,” *Data Communications* (1 Jan. 1989a).

<sup>102</sup> “cisco,” short for San Francisco, with a lower-case initial “c,” was the company’s name until it went public in 1990.

<sup>103</sup> *San Francisco Chronicle*, 27 Jan. 1988, B3; Bob Bellinger, “The Spark of Silicon Valley,” *Electronic Engineering Times*, 13 March 1989; John T. Mulqueen, “Industry Watch: Connecting Nets, a Growth Business T1 Links Take Bridge and Router Sales to New, and Brighter, Horizons,” *Data Communications* (1 July 1989b).

member of Cisco's board of directors. During 1988, Valentine directed the hiring of professional managers at Cisco, including John Morgridge, who had run Grid Computer in nearby Fremont, as Cisco president and CEO. More generally, with over a quarter century of experience as a manager and financier in Silicon Valley, Valentine provided Cisco with business expertise that was based on an intimate understanding of the industrial environment in which the firm was trying to compete.

In 2004, Morgridge was chairman of the board of Cisco while Valentine remained a board member. Beyond the initial professionalization of the company in the late 1980s, Morgridge and Valentine oversaw the phenomenal growth of Cisco from less than \$28 million in sales in the year ending July 1989 to over \$22 billion in sales in the year ending July 2001. The ways in which Cisco financed this growth as a publicly traded company exemplify NEBM.

The IPO itself in February 1990 netted the company \$48 million that was used for working capital and cash reserves. Funds from operations easily covered the company's capital expenditures, not only in 1990, but also for every subsequent year. In fact, 1990 was the only time that Cisco raised funds on financial markets; the company has done no further public stock offerings and has never incurred debt. At the same time, typifying NEBM, Cisco has never paid any dividends. Of the twenty New Economy companies listed in Table 2, the only ones that have paid cash dividends are Microsoft in 2003 and 2004, Intel since 1992, EMC in 1996, and Apple from 1987 through 1995.

While Cisco has not raised any funds on securities markets since going public in 1990, the company has taken in \$7.4 billion from the sale of stock, with just over half of this amount in the fiscal years 1999-2001.<sup>104</sup> The buyers have been its employees, exercising their stock options; these were not issues to the public. In addition, Cisco has been able to claim a total of \$7.5 billion in tax credits for income taxes paid by its employees when they have exercised stock options.<sup>105</sup> Of this total in tax credits, \$5.9 billion, or 76 percent, came in fiscal 1999-2001.

The practice of extending stock options to a broad base of employees means that a substantial proportion of the shares outstanding of a company like Cisco are committed to stock option programs. As shown in Figure 1, the proportion of stock options outstanding to common shares outstanding at Cisco rose from 7.4 percent in 1994 to 20.0 percent in 2004. The increase in this proportion since 2000 occurred because, with

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<sup>104</sup> Carpenter, Lazonick, and O'Sullivan, "The Stock Market and Innovative Capability in the New Economy," 993.

<sup>105</sup> Under the Economic Recovery Tax Act of 1981, a company is permitted to take a tax credit equal to the amount of taxes that employees pay on the gains that they make from exercising stock options that are taxable as ordinary income; see Richard L. Hubbard, "IRS Gives Some Answers on Incentive Stock Options," *Legal Times*, 11 Jan. 1982.

Cisco's stock price down from its high levels in the late 1990s, a significant proportion of the outstanding options (48 percent of options exercisable as of July 30, 2004) has been "under water."<sup>106</sup> To support the company's stock price, and put more of these stock options "in-the-money," Cisco repurchased its own stock for \$16.9 billion during 2002-2004, \$9.1 billion in 2004 alone.

As the case of Cisco illustrates, NEBM places a heavy emphasis on maintaining high stock prices. In pursuing this corporate objective, a need to raise funds on the stock or convertible bond markets has not been the main driver in NEBM. Nor has a desire to avoid a hostile takeover; such bids have rarely happened with high-tech companies because of the ease with which a firm's most valuable assets can walk out the door—although the recent hostile takeover of PeopleSoft by Oracle, carried out in a period of relatively weak ICT labor markets, may signal a new trend.<sup>107</sup>

The main impetus to maintaining a high stock price has been the use of a company's own stock as a currency to compensate personnel and acquire other companies. In the case of Cisco, throughout its history it has used stock options as a partial mode of compensation for all of its employees, even as its headcount grew from 254 people in 1990 at the time of its IPO to over 40,000 during 2000. In periods when its stock price has sagged, the company has entered the market to repurchase its own shares—at times, as we have seen, on a massive scale.

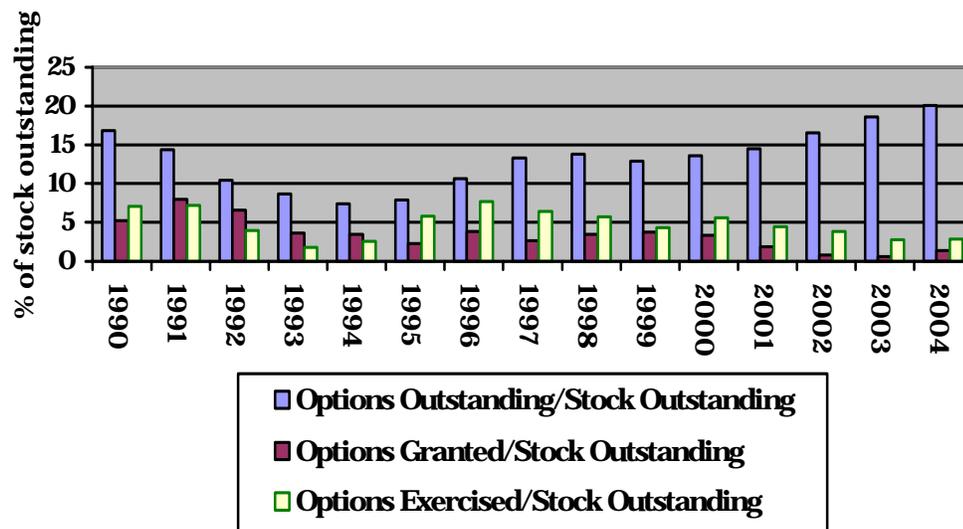
In addition, again exemplifying a mode of finance that became a feature of NEBM in the 1990s, Cisco has used stock rather than cash to acquire other companies (see Table 4). From 1993 through 2004 Cisco made ninety-four acquisitions valued in nominal terms at almost \$39 billion, over 96 percent of which was paid in the company's stock rather than cash. In 1999 and 2000, years in which Cisco expended 69 percent of the total value (in nominal dollars) of its acquisitions, over 99 percent took the form of stock.

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<sup>106</sup> *Cisco Systems 2004 Annual Report*, 60.

<sup>107</sup> Both Oracle (with 2003 revenues of \$9.5 billion and 40,650 employees) and PeopleSoft (with 2003 revenues of \$2.3 billion and 12,163 employees) are Silicon Valley-based providers of enterprise software. From the outset of the hostile bid, launched in June 2003, Oracle made it clear that it was after PeopleSoft's 13,000-strong customer base and that it intended to lay off about half of PeopleSoft's employees, although making a special effort to retain its core of developers, application designers, and quality-assurance specialists, undoubtedly through stock option awards. See David Bank, "New Code: After 18-Month Battle, Oracle Finally Wins Over PeopleSoft," *Wall Street Journal*, 14 Dec. 2004; John Pallatto, "Time for PeopleSoft Customers, Workers to Cut Best Deal," *eWeek*, 20 Dec. 2004.

FIGURE 1  
Cisco's Stock Options, 1990-2004



Note: Options Outstanding/Stock Outstanding based on end of fiscal year data; Options Granted/Stock Outstanding and Options Exercised/Stock Outstanding based on an average of stock outstanding at the beginning and end of the fiscal year.

Source: Cisco Systems *Annual Reports*.

Cisco's practice of an almost complete reliance on stock as an acquisition currency changed, however, starting with the acquisition of Latitude Communications, based in Santa Clara, California, for \$86 million in cash in November 2003, and continuing with the twelve acquisitions that Cisco made, all with cash, in 2004. There could be a number of reasons why Cisco reversed its practice of using stock as an acquisition currency. Since July 2001, the Financial Accounting Standards Board (FASB) has outlawed pooling-of-interests accounting, a practice that enabled a company that made an all-stock acquisition to put the book value rather than the market value of the acquisition on its balance sheet, thus reducing future amortization charges and increasing future reported earnings. Cisco was known for its use of this accounting device, one that, by inflating the company's reported earnings, presumably boosted its stock price.<sup>108</sup> This explanation, however, is clearly only a partial one, because Cisco made ten all-stock acquisitions between July 2001 and March 2003, when the new FASB ruling was in place. At best, the ruling made Cisco indifferent from an accounting point of view between the use

<sup>108</sup> See Thomas Donlan, "Cisco's Bids," *Barron's* (8 May 2000), 31-34.

of cash and stock in acquisitions. In fact, Cisco's stock price was generally higher from November 2003 to December 2004 than it had been from July 2001 to October 2003, which, all other things being equal, should have encouraged the use of stock rather than cash for acquisitions—just the opposite of what Cisco actually did.

Cisco probably tilted toward the use of cash because it had current assets of over \$14 billion on its balance sheet throughout fiscal 2004, and, given its massive stock repurchase program, the use of stock to acquire companies would have just increased the number of shares it would then have had to repurchase to reduce dilution to a desired level.<sup>109</sup> It is also the case that Cisco paid much less on a per employee basis for its recent cash acquisitions than it had paid for its stock-based acquisitions, reflecting perhaps a preference by the owners of the acquired firms for hard cash rather than volatile stock. With 183 employees, the cost per employee of the Latitude acquisition in November 2003 was \$470,000, the lowest amount for any of Cisco's eighty-two acquisitions up to that point. And, at \$860,000, the average cost per employee of Cisco's 2004 acquisitions was only 21 percent of the average of \$4,160,000 for all its ninety-three acquisitions (see Table 4), and would be much less if one were to correct for consumer or producer price inflation. But then perhaps one would also want to "correct" for the stock-price inflation of the Internet boom that made it possible for Cisco to pay an average of over \$6 million per employee for its acquisitions in 1999-2000.

### **Evolution of NEBM: Labor**

The distinctive characteristic of employment in NEBM is the interfirm mobility of labor. Especially within Silicon Valley, but even on a national and international scale, high-tech employees tend to move from one company to another over the course of their careers.<sup>110</sup> Encouraging this interfirm movement of people have been opportunities provided by startups; a large influx of new highly educated foreigners, on both immigrant and non-immigrant visas, into the United States; an intensity of work that often results in employee "burn-out"; and the use of broad-based stock option plans as an inducement for employees to leave one firm for another.<sup>111</sup>

The prevalence of stock options as a mode of compensation manifests the importance of interfirm labor mobility in NEBM. Stock options are

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<sup>109</sup> Olaf de Senerpont Domis, "Latitude for Change," *Daily Deal*, 1 Dec. 2003.

<sup>110</sup> See Saxenian, *Regional Advantage*; Alan Hyde, *Working in Silicon Valley: Economic and Legal Analysis of a High-Velocity Labor Market* (Armonk, N.Y., 2003).

<sup>111</sup> See Stephen S. Cohen and Gary Fields, "Social Capital and Capital Gains in Silicon Valley," *California Management Review* 41 (Winter 1999): 108-30.

TABLE 4  
Cisco Systems Acquisitions, 1993-2004  
(by value, employees, and mode of payment)

Calendar year	No. of firms acquired	Total value paid (\$millions)	Average value per acquisition (\$millions)	% of acquisition value paid in shares	No. of employees at acquired firm	Value per employee (\$millions)	"Acquired" employees/Cisco employees % <sup>a</sup>
1993	1	89	89	100.00	60	1.48	4.1
1994	3	423	141	71.63	320	1.32	13.1
1995	4	702	176	100.00	205	3.42	5.0
1996 <sup>b</sup>	7	5,618	803	97.67	1,547	3.63	17.6
1997 <sup>c</sup>	6	614	102	72.13	210	2.92	1.9
1998	9	1,144	127	99.85	722	1.58	4.8
1999	18	14,435	802	99.83	2,363	6.11	11.3
2000	23	12,254	533	98.80	2,045	5.99	6.0
2001	2	331	166	100.00	91	3.64	0.2
2002	5	1,789	358	100.00	418	4.28	1.2
2003	4	754	189	88.59	550	1.37	1.6
2004	12	793	66	0.00	886	0.90	2.65
Totals	94	38,945	414	96.21	9,417	4.14	

## Notes:

<sup>a</sup> Calculated as proportion of total number of people employed by target companies at the time that they were acquired by Cisco divided by the number of Cisco employees at the end of its fiscal year (last week in July). It is not known what proportion of these target-company employees actually became Cisco employees.

<sup>b</sup> Acquisition cost of Metaplex, with nineteen employees, not disclosed. For the purpose of this table Metaplex is valued at the average value per employee of other acquisitions in 1996.

<sup>c</sup> Acquisition cost of Telesend, with ten employees, not disclosed. For the purpose of this table Telesend is valued at the average value per employee of other acquisitions in 1997.

Sources: Updated from Carpenter, Lazonick, and O'Sullivan, "The Stock Market and Innovative Capability in the New Economy," 982. Compiled from press releases on <http://www.cisco.com> and news reports.

granted to an employee as part of a compensation package that generally includes a salary based on one's hierarchical and functional position, medical and pension benefits, and, in some cases, variable remuneration such as bonuses, performance awards, and (for an executive) restricted stock. A stock option gives the employee the non-transferable right to purchase a certain number of shares of the company for which he or she works at a pre-set "exercise" price between the date the option "vests" and the date it "expires." Typically, in U.S. option grants, the exercise price is the market price of the stock at the date the option is granted; the vesting period is spread over one to four years from the date of the grant; and the expiration date is ten years from the date of the grant. Unvested options usually lapse ninety days after termination of employment with the company.

Although broad-based stock option plans that extend to non-executive personnel are a quintessentially Silicon Valley phenomenon, stock options as a mode of compensation have their origins in the Old Economy.<sup>112</sup> From the late 1930s, in the wake of the New Deal, high-level executives of major corporations, in search of a way to avoid paying marginal tax rates of as much as 91 percent on their personal incomes, seized on the possibility that income from exercising stock options could be subject to capital gains taxation at a rate of 25 percent. The Revenue Act of 1950 transformed this possibility into reality, and over the course of the 1950s, top managers of U.S. corporations saw income from options become an important component of their total income. In the late 1950s and early 1960s, however, a backlash of public sentiment against this enrichment of top managers led the U.S. Congress to place restrictions on the use of stock options as a mode of compensation. In 1969 and 1976, moreover, Congress raised the capital gains rate and lowered the personal income rate, thus mitigating the original purpose of options. In 1978, Graef Crystal, a compensation consultant who would later become a vocal critic of excessive executive pay, stated that qualified stock options, ". . . have been given the last rites by Congress."<sup>113</sup>

That was not the end of executive stock options, however. Congress subsequently lowered both the personal income and capital gains rates and relaxed the rules on the granting and exercising of stock options, thus resuscitating them. The 1980s and 1990s witnessed an explosion in executive pay, driven by stock options. Between 1980 and 1994, the mean value of stock option grants to CEOs of large U.S. corporations rose from \$155,037 to \$1,213,180, or by 683 percent, while the mean value of their

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<sup>112</sup> William Lazonick, "Stock Options as a Mode of High-Tech Compensation," INSEAD working paper, 2003.

<sup>113</sup> Graef Crystal, *Executive Compensation* (New York, 1978), 145; Graef Crystal, *In Search of Excess: The Overcompensation of American Executives* (New York, 1991).

salary and bonus compensation rose from \$654,935 to \$1,292,290 million, or by 95 percent. As a result, stock options accounted for 19 percent of CEO compensation in 1980, but 48 percent in 1994.<sup>114</sup> In 2000, the average CEO compensation of the largest two hundred U.S. corporations by sales was \$11.3 million, of which stock options generated 60 percent; restricted stock, 11 percent; bonuses, 18 percent; and salary, 9 percent.<sup>115</sup> Stock option income as a proportion of executive pay was highest in ICT firms.<sup>116</sup>

However, the growing use of stock options during the 1980s and 1990s cannot be understood simply in terms of executive pay. The vast majority of option grants now go to non-executive personnel, especially in ICT.<sup>117</sup> In the two hundred largest U.S. companies by sales in 2000 and 2001, 15.5 percent of all options went to the five highest paid executives, whose compensation companies report in the proxy statements issued in advance of the annual general meeting of shareholders. Therefore, other corporate employees, some of whom were executives (but most of whom were not) received, on average, almost 85 percent of options granted. Because they compete disproportionately for technology personnel, ICT companies grant a lower proportion of options to the top five executives than firms in other industries. Cisco's five highest paid executives, for example, received 2.4 percent of all options granted in 2000 and 2.8 percent in 2001. Those low proportions, however, did not prevent Cisco's CEO, John Chambers, from making \$120.8 million from exercising stock options in 1999, and another \$156.0 million in 2002, nor the other four highest paid Cisco executives from averaging \$24.9 million from stock options in 1999 and \$36.7 million in 2000.<sup>118</sup>

During the New Economy boom, broad-based stock option programs diffused to many more companies, with top executives getting more of them and increasing numbers of non-executive employees getting them for the first time. In a "near-constant" sample of 350 U.S.-based companies, the proportion that made provision for broad-based plans rose from 17.4 percent in 1993 to 54.0 percent in 2000, while the proportion that made grants under those plans rose from 5.7 to 22.0 percent.<sup>119</sup> The use of stock

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<sup>114</sup> Brian J. Hall and Jeffrey B. Leibman, "Are CEOs Really Paid Like Bureaucrats?" *Quarterly Journal of Economics* 113 (Aug. 1998): 653-91, 661.

<sup>115</sup> Pearl Meyer & Partners 2001, "Trends 2001: Looking Forward and Back"; URL: <http://www.execpay.com/trends2001.htm>.

<sup>116</sup> Mark C. Anderson, Rajiv D. Banker, and Sury Ravindran, "Executive Compensation in the Information Technology Industry," *Management Science* 46 (April 2000): 530-47.

<sup>117</sup> iQuantic-Buck, 2002, "Stock Options: Industry Practices and International Accounting Board Proposals," Buck Consultants.

<sup>118</sup> Carpenter, Lazonick, and O'Sullivan, "The Stock Market and Innovative Capability in the New Economy," 990.

<sup>119</sup> S. Sabow, and E. Milligan, "Trends in Broad-Based Stock Option Plans," *Journal of Employee Ownership Law and Finance* 12 (Spring 2000): 99-105,

options for non-executive personnel had its origins in Silicon Valley beginning in the 1960s and became omnipresent by the late 1990s, as startups from semiconductors to microcomputers to internetworking sought to attract talent. For startups, options could also be a way of conserving cash and hence financing growth. Around 1990, in Silicon Valley, established firms paid \$65,000 for an electrical engineer with ten years of experience, whereas startups paid \$40,000 plus stock options.<sup>120</sup> For the employee, the hope was that the options, which had exercise prices in the pennies when the grants were made in the startup phase, would be worth a small fortune if and when the new venture did an IPO or a private sale to a publicly traded corporation.

That the growth of non-executive stock options is a Silicon Valley phenomenon, there is no doubt. A *Factiva* search was done on December 10, 2004 to compare the importance of stock options as a mode of compensation in Silicon Valley and Route 128. A search on “stock options” and “compensation” and “*Silicon Valley*” generated 2,496 hits (representing 3.5 percent of all hits on “stock options” and “compensation,” with the earliest hit on September 12, 1983 and 95 percent of the hits from January 1, 1995). A *Factiva* search on “stock options” and “compensation” and “*Route 128*” yielded only 34 hits (earliest September 9, 1984, and 85 percent from January 1, 1995), a ratio of Silicon Valley hits to Route 128 hits of 73:1. Moreover, 31 of the 34 “Route 128” items also included “Silicon Valley.” As a control, single-phrase searches on “Silicon Valley” and “Route 128” produced 277,389 and 12,981 hits, respectively, for a leading high-tech district hit ratio of 21:1.

There is no adequate documentation of the evolution of non-executive stock options as a mode of compensation in Silicon Valley firms from the 1960s through the 1980s. Beyond the data in proxy statements on the percentage of stock options allocated to the CEO and the other four highest paid executives, company filings provide no systematic evidence on the distribution of options among employees. Even though U.S. corporations have been obliged to publish information on their stock option programs in their 10-K filings since 1994, the evidence on who gets what remains fragmentary.<sup>121</sup>

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100; Mercer Human Resource Consulting, 2001, “Future of Equity—2003 Update,” June; URL: <http://www.mercerhr.com>.

<sup>120</sup> Louis Uchitelle, “Unequal Pay Widespread in US,” *New York Times*, 14 Aug. 1990.

<sup>121</sup> For a case study of a non-U.S. based company that provided the researchers with full access to information, see Henrik Glimstedt and William Lazonick, “The Evolution of Stock Options at Ericsson,” INSEAD working paper, Jan. 2005. Annual surveys done since 1996 by iQuantic and (now) Mellon Consulting also provide option distribution information for groups of ICT firms by industry and size.

Intel extended stock options to all of its professional personnel (but not to its clerical and production employees) from its founding in 1968, and by 1984, 5,000, or about one-fifth of its worldwide employees, were receiving them.<sup>122</sup> Coming into 1997 Intel offered stock options to the 25 percent of its labor force deemed to be “key employees.” In February 1997, however, Intel announced that it would henceforth be offering stock options to all of its 50,000 regular employees, thus following a practice that had become common among younger Silicon Valley companies.<sup>123</sup> It was subsequently revealed in April 1997 that in 1996, Intel CEO Andrew Grove had made \$96.4 million from exercising stock options, the highest of any corporate executive in that year and over 50 percent greater than the second highest. Within the corporation, it is easier to legitimize such high returns to top executives when a broad base of employees in the organization can also gain from rising stock prices.

For NEBM employees, stock options are not only a potential form of remuneration for work, but also, they hope, a source of retirement savings. New Economy companies almost invariably have defined-contribution rather than defined-benefit pension schemes, often with a low level of contribution by the company. The expectation is that the accumulation of wealth through the exercise of stock options will form a much more significant financial foundation for retirement than the company pension plan *per se*.

There is a widespread consensus among ICT firms that the prime function of stock options is to manage interfirm mobility on the labor market, as shown by the relative importance ascribed to different functions of stock options by ICT compensation executives who responded to iQuantic’s annual survey (see Figure 2). Note the stability of the relative rankings between 1996 and 2003, as well as the upward movement in the importance ascribed to the “attract” function to 2000.

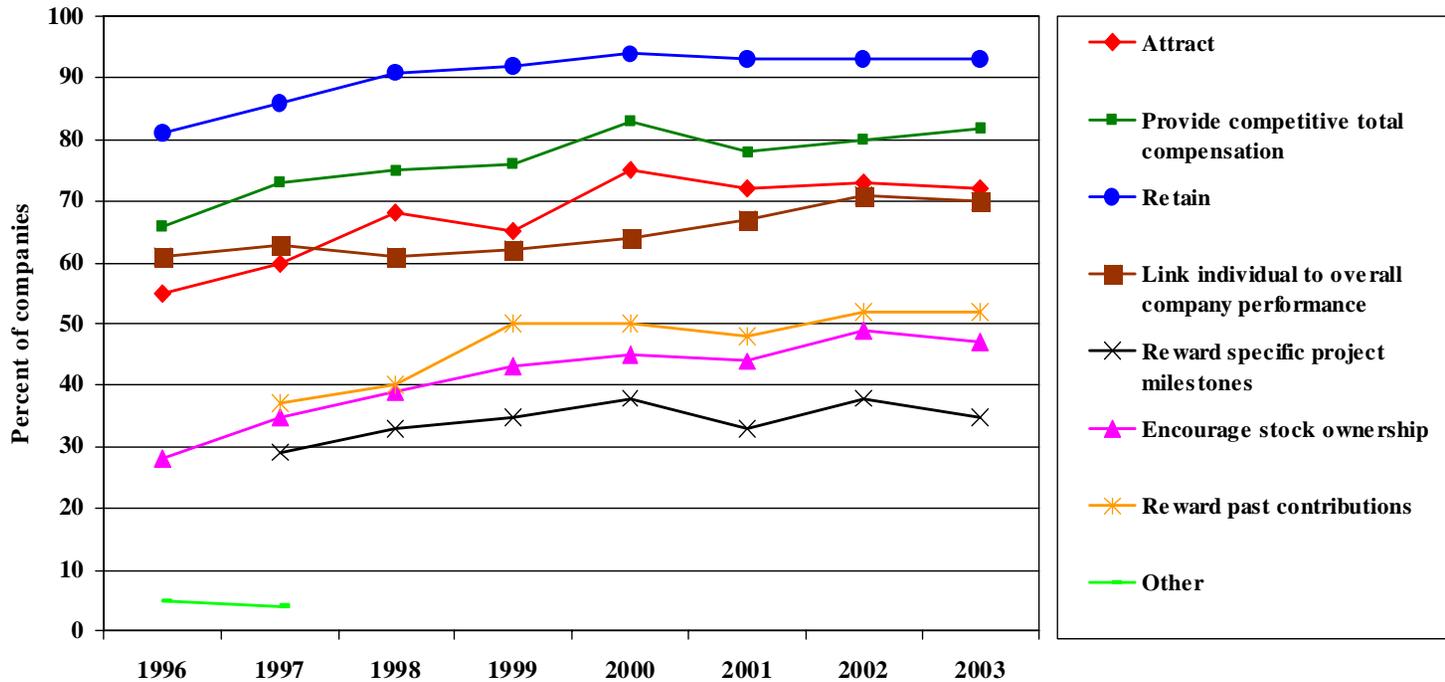
The practice of allocating stock options to a broad base of employees is made easier in NEBM by the fact that New Economy companies increasingly employ predominantly highly educated professional, technical, and administrative personnel; some New Economy firms employ few if any production workers. One result is that ICT has not been fertile territory for union organization. It is difficult to organize workers who have the option of “exit” via the labor market instead of “voice” via union representation, which in good times a district like Silicon Valley can provide. In addition, many work for companies that, to counter the threat of unionization, can outsource work or offer the relatively small number of non-salaried workers that they still employ higher pay or even stock options.

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<sup>122</sup> Tim Jackson, *Inside Intel: Andy Grove and the Rise of the World’s Most Powerful Chip Company* (New York, 1997), 112, 318.

<sup>123</sup> Ilana DeBare, “Intel Options Go Companywide,” *San Francisco Chronicle*, 12 Feb. 1997.

FIGURE 2  
 Relative Importance of Objectives of On-Going Stock Option Programs, ICT Companies Operating in the United States, 1996-2003



Notes: Index of importance of objectives is 0-100, with 100 as “most important.” The identities of the ICT companies included in the survey shifts from year to year. The number of companies surveyed were: 1996, 68; 1997, 68; 1998, 82; 1999, 81; 2000, 180; 2001, 166; 2002, 174, 2003, 136. In 1996, “Rewarding past contributions” was a frequent response in the “Other” category.

Sources: 1996-1997: iQuantic High-Tech Equity Practices Survey; 1998-2000: iQuantic Equity Practices Survey for High Technology Industries; 2001-2002: iQuantic-Buck Information Services Equity Practices Survey for the High Technology Industries; 2003: Mellon Equity Practices Survey for the High Technology Industries (April 2004).

In 1985, when the Silicon Valley semiconductor industry was beset by Japanese competition, Gordon Moore of Intel was quoted as saying: “Our industry changes so rapidly, and the nature of the jobs changes continuously. I think [the lack of unionization] has served the industry well.”<sup>124</sup> Similarly, in his book, *Spinoff*, Charles Sporck, the CEO of National Semiconductor and a major figure in the semiconductor industry, contends that

unions have a way of evolving into extremely stubborn obstacles to innovation. We were constantly changing assignments around to make best use of individual talents and skills. It would have been impossible to move ahead with the rapidly developing technology of semiconductors in an organization hampered by union formalities.<sup>125</sup>

Whether or not one accepts these judgments by Silicon Valley’s top executives on the incompatibility of unions with NEBM, the fact is, as Sporck put it, “no semiconductor facility in Silicon Valley was ever unionized.”<sup>126</sup> In the mid-1970s, the United Auto Workers had gotten as far as a representation ballot at one of Intel’s plants, but four out of five eligible employees rejected the union.<sup>127</sup> Attempts by U.S. unions to organize Silicon Valley employees in the mid-1980s came to naught.<sup>128</sup> Indeed, the only successful union organizing in Silicon Valley has been of the janitorial labor force. In 1992 Hewlett-Packard agreed to employ a janitorial contractor whose employees were represented by the Service Employees International Union (SEIU).<sup>129</sup> In addition, in 1996, a SEIU official announced that “every major high-tech company is cleaned by a union janitorial company except for Intel.”<sup>130</sup> By the end of the decade, amid the affluence of the high-tech boom, there was a general acceptance among Silicon Valley’s high-tech employers that the people—most of them Hispanic immigrants—who cleaned their facilities needed collective bargaining to bolster their meager pay. Even Intel, which remained adamantly nonunion, paid its janitors at the union rate.<sup>131</sup>

As for Silicon Valley employees who were the beneficiaries of stock options, their relatively high base salaries and the extra incomes that they

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<sup>124</sup> Michael Malone, “Union Worries Add New Cloud to High-Tech Industry’s Horizon,” *Dallas Morning News*, 10 Aug. 1985.

<sup>125</sup> Sporck, *Spinoff*, 271.

<sup>126</sup> *Ibid.*

<sup>127</sup> Jackson, *Inside Intel*, chap. 16.

<sup>128</sup> Michael W. Miller, “Unions Curtail Organizing in High Tech,” *Wall Street Journal*, 13 Nov. 1984; Kathy Sawyer, “Unions Striking Out in High-Tech Firms,” *Washington Post*, 18 March 1984.

<sup>129</sup> *U.S. Newswire*, 6 Aug. 1992.

<sup>130</sup> Stanley Holmes, “Unionizing the Nerds,” *PC Week*, 28 Oct. 1996.

<sup>131</sup> Carrie Kirby, “Sweeping Proposal: Janitors Look to Silicon Valley Giants for Help in Pay Dispute,” *San Francisco Chronicle*, 20 May 2000.

reaped from the exercise of options at the peak of the Internet boom lured them into believing that “the market” would bring them ample rewards. Figures 3 through 6 show the changes in regular employment and real wages for two ICT sectors—semiconductors and software publishing—from 1994 through 2002 for three districts in the United States with a high concentration of ICT workers. ICT incomes were higher in Silicon Valley than along Route 128, in the Dallas area, and in the United States as a whole, with the sharp increases in pay of 1999 and 2000 reflecting the exercising of options at the stock market’s peak. Subsequently in 2001 and 2000, wages moved sharply downward (with the exception of the relatively small Route 128 semiconductor sector where wages increased somewhat from 2001 to 2002). Both semiconductors and software publishing saw significant growth of employment into 2001, but then sharp declines in 2002, with employment in semiconductors falling below its level of 1994. While the patterns of change in employment and earnings showed some variation across industries and districts over time, the overall picture is that, as one would expect, what went up in the boom of the late 1990s came down in the bust of the early 2000s.

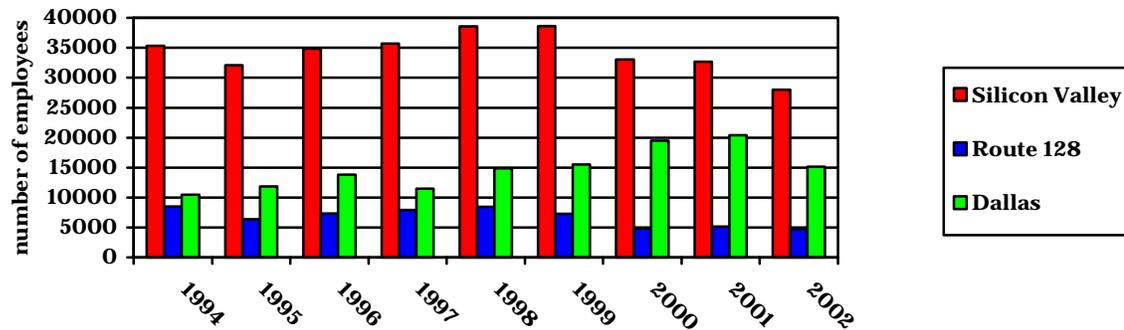
The decline in GDP that accompanied the end of the Internet boom lasted from March to November 2001. Subsequently, however, with the resumption of growth, there was a contraction in employment in the U.S. economy as a whole until the fourth quarter of 2003. In this jobless recovery, certain ICT occupational categories were hit particularly hard. Fourth-quarter surveys by the Bureau of Labor Statistics show employment of computer programmers in the United States falling from 530,730 in 2000 to 501,580 in 2001 to 457,320 in 2002 to 403,220 in 2003, with average real annual wages declining from a peak of \$65,517 in 2001 to \$65,170 in 2003. Fourth-quarter employment of electrical and electronic engineering technicians fell from 244,570 in 2000 to 220,810 in 2001 to 194,960 in 2002 to 181,550 in 2003, although the average real annual wages of those who remained employed rose from \$33,155 in 2000 to \$46,190 in 2003.<sup>132</sup> The Institute of Electrical and Electronics Engineers (IEEE) estimated an unemployment rate for computer programmers of 6.4 percent on average in 2003 and 7.6 percent on average in the first half of 2004.<sup>133</sup> The problem, it was widely argued, was a marked acceleration in the 2000s of the “offshoring,” especially to India, of what had been well-paid ICT jobs in the United States. Even in recovery, it seemed, the New Economy was failing to deliver on the promise of prosperity even to many of the better-educated groups in the U.S. labor force.

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<sup>132</sup> <http://www.bls.gov/oes/home.htm>.

<sup>133</sup> [http://ewh.ieee.org/r5/central\\_texas/employment.html](http://ewh.ieee.org/r5/central_texas/employment.html).

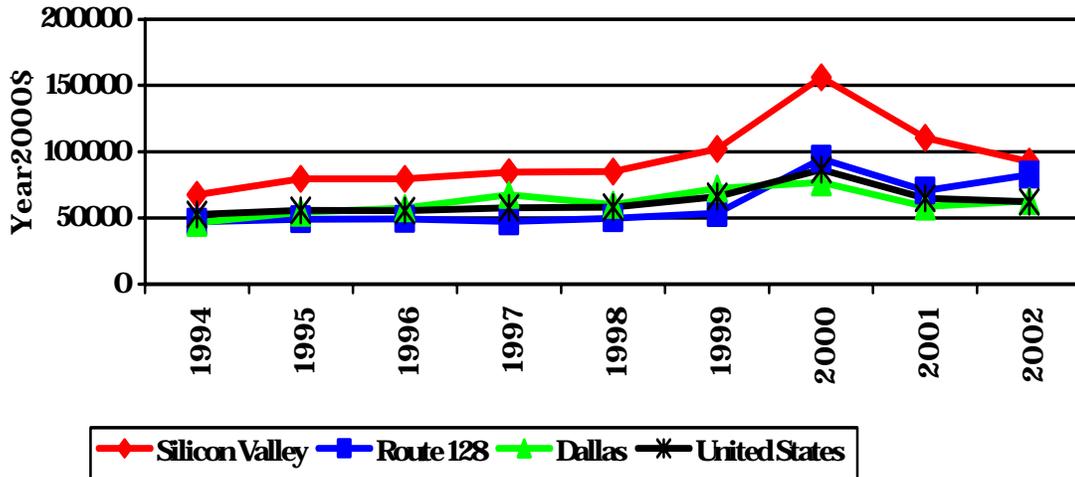
FIGURE 3  
Semiconductor Employees (Full-Time) Silicon Valley, Route 128, Dallas  
USA, 1994-2002



Year	Silicon Valley		Route 128		Dallas		USA
	#	%	#	%	#	%	
1994	35,314	20.6	8,489	4.9	10,460	6.1	171,766
1999	38,635	18.8	7,264	3.5	15,533	7.6	205,296
2000	33,045	15.6	4,829	2.3	19,506	9.4	207,211
2001	32,656	14.5	5,154	2.3	20,444	9.1	225,078
2002	28,004	16.4	4,731	2.8	15,144	8.9	170,775

SIC 3674; NAICS 334413  
Source: U.S. Bureau of the Census.

FIGURE 4  
Average Real Annual Earnings, Full-Time Employees, Semiconductors  
Silicon Valley, Route 128, Dallas, USA, 1994-2002



SIC 3674; NAICS 334413.

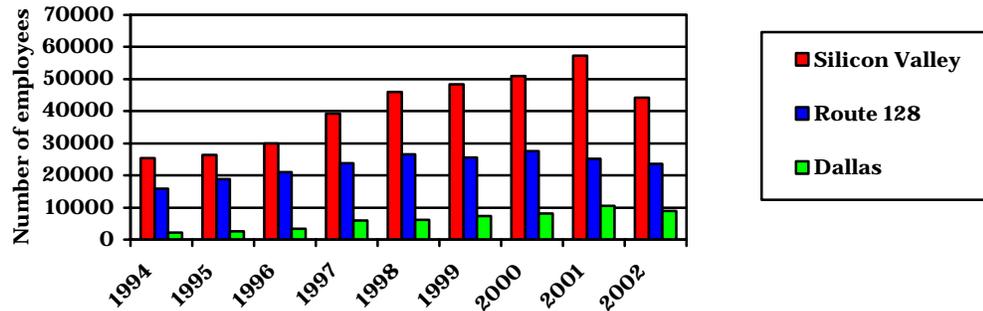
Source: U.S. Bureau of the Census.

### IBM and the End of the “Organization Man”

That NEBM had become the dominant mode of business organization in the ICT industries by the 2000s, there is little doubt. During the 1990s, leading Old Economy ICT companies sought to adopt elements of NEBM. Lucent Technologies, spun off from AT&T in 1996, made the attempt in the last half of the 1990s to become a New Economy company, but, as has been detailed elsewhere, in the process came close to destroying itself as a viable business organization.<sup>134</sup> Not so with IBM. In the 1980s, the IBM PC had consolidated the vertical structure of the microcomputer industry. In the 1990s, IBM’s own organizational transformation ensured the dominance of NEBM in the U.S. ICT industries.

<sup>134</sup> Carpenter, Lazonick, and O’Sullivan, “The Stock Market and Innovative Capability in the New Economy.”

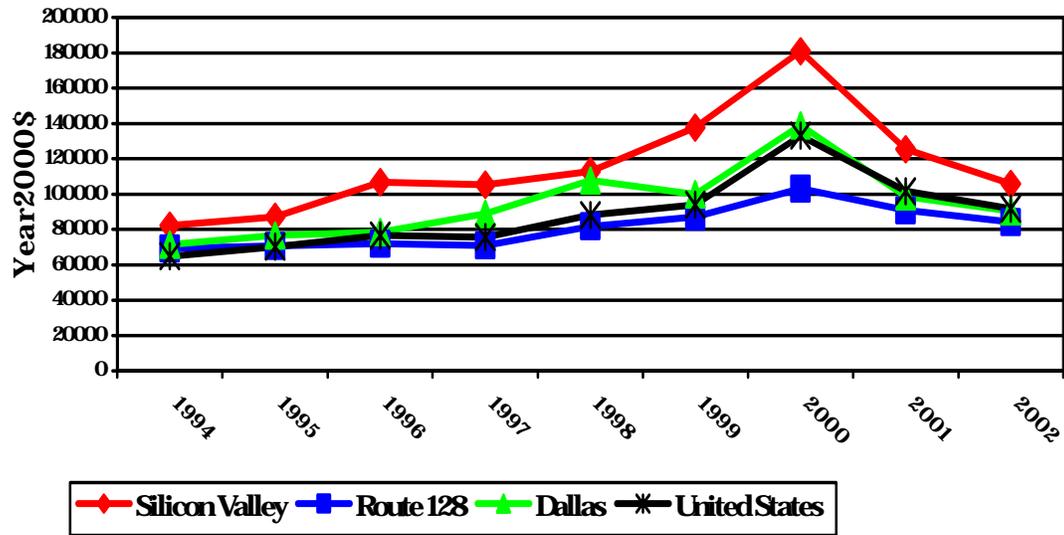
FIGURE 5  
Software Publisher Employees (Full-Time), Silicon Valley, Route 128,  
Dallas, USA, 1994-2002



SIC 7372; NAICS 511210  
Source: U.S. Bureau of the Census.

Year	Silicon Valley		Route 128		Dallas		USA
	#	%	#	%	#	%	
1994	25,429	17.0	15,949	10.6	2,201	1.5	149,911
1999	48,427	15.9	25,613	8.4	7,289	2.4	304,663
2000	50,941	15.4	27,500	8.3	8,152	2.5	331,485
2001	57,231	16.2	25,173	7.1	10,508	3.0	353,344
2002	44,213	14.2	23,674	7.6	8,827	2.8	312,102

FIGURE 6  
Average Real Annual Earnings, Full-Time Employees, Software Publishers Silicon Valley, Route 128, Dallas, USA, 1994-2002



SIC: 7372; NAICS 511210

Source: U.S. Bureau of the Census.

In 1991-1993, IBM's annual revenues dropped for three successive years. The average revenue during those three years was \$64.0 billion, just over 7 percent less than 1990 revenues of \$69.0 billion, but greater than the company's average revenues for the years 1988-1990. Especially given that the U.S. economy was going through a major recession, IBM's problem was not in its ability to generate sales. Yet not since 1946 had IBM experienced a year-to-year decline in revenues, and with shrinking gross profit margins from 1991 and 1991-1993 deficits totaling \$15.9 billion, it appeared that IBM had lost its way.

From 1994 through 2003, however, IBM came back, its revenues rising from \$64.1 billion to \$89.1 billion, notwithstanding revenue declines in 2001 and 2002. The company increased its employment level from 220,000 in 1994, the lowest since 1966, to 320,000 in 2001, a level that it almost matched in 2003. Moreover, in 2003 U.S. dollars, IBM's sales per employee increased from an annual average of \$220,000 in 1981-1990 to \$320,000 in 1994-2003, although that figure fell over the latter period as IBM's employment level was restored. Over the 1994-2003 decade, IBM's net income averaged \$5.8 billion, 7.4 percent of revenues. The fact that this profit rate was well below the 10.4 percent profit rate that IBM recorded during 1981-1990, and the rate of 13.2 percent in the first half of

that decade, reflects the much more competitive “New Economy” environment that IBM faced.<sup>135</sup>

During the 1990s, IBM pursued a strategy of shifting its business out of hardware into services.<sup>136</sup> Continuing a trend that began in the late 1980s, the share of revenues from hardware declined from 48 percent in 1996 to 32 percent in 2003, while the services share increased from 29 percent to 48 percent. Hardware margins (gross profits as a percent of gross revenues) trended downward from about 37 percent in the mid-1990s to 28 percent in the early 2000s, while services margins stayed relatively stable at 25 to 28 percent. Software’s share of revenues remained at 15 to 16 percent from 1996 to 2003, but the segment’s already high profit margins increased fairly steadily from 74 percent in 1996 to almost 87 percent in 2003. As a result, the software segment accounted for 38 percent of gross revenues in 2003, compared with 33 percent for services and 24 percent for hardware.<sup>137</sup> In December 2004, IBM’s strategy of shifting out of hardware continued with its sale of its PC business to Lenovo, an indigenous Chinese computer electronics company formerly known as Legend.<sup>138</sup>

These changes in product market strategy have been accompanied by significant reductions in IBM’s R&D expenditures as a percentage of sales. A clear-cut break in IBM’s R&D expenditures occurred between 1992 and 1994 (see Figure 7), as it adjusted to its losses and as Louis Gerstner arrived on the scene. The company’s R&D expenditures averaged 9.84 percent of sales for the decade 1983-1992 compared with 6.09 percent for the decade 1994-2003. In 2003, IBM’s total expenditures of \$5.1 billion on R&D placed it ninth among all R&D spenders globally. But its R&D expenditures of \$16,000 per employee were lower than all but seven other companies in the list of top fifty R&D spenders, far lower than 14<sup>th</sup>-place Intel’s \$55,000, 29<sup>th</sup>-place Cisco’s \$92,000, and 1<sup>st</sup>-place Microsoft’s \$141,000.<sup>139</sup>

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<sup>135</sup> IBM *Annual Reports*, various years.

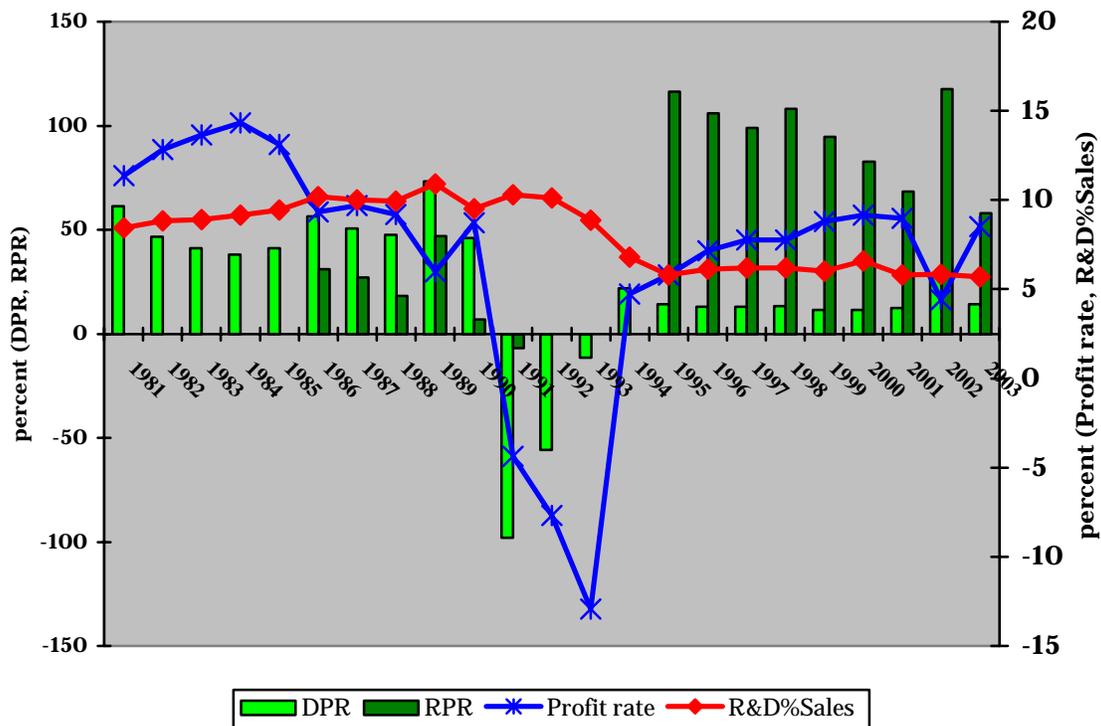
<sup>136</sup> Doug Garr, *IBM Redux: Lou Gerstner & the Business Turnaround of the Decade* (New York, 1999); Glimstedt and Lazonick, “The Evolution of Stock Options at Ericsson”; Steve Lohr, “I.B.M. Sought a China Partnership, Not Just a Sale,” *New York Times*, 13 Dec. 2004.

<sup>137</sup> IBM *Annual Reports*, various years.

<sup>138</sup> See Qiwen Lu, *China’s Leap into the Information Age* (New York 2000); Lohr, “I.B.M. Sought a China Partnership, Not Just a Sale.”

<sup>139</sup> Harry Goldstein and Ronil Hira, “Spectrum R&D 100: The World’s Biggest R&D Spenders are Putting Their Money on Software and Service,” *IEEE Spectrum* (Nov. 2004).

FIGURE 7  
IBM's Profit Rate, Rate of R&D Spending, and Payout Behavior,  
1981-2003



DPR=Dividend payout rate (dividends as a percent of net income)  
RPR=Repurchase payout rate (stock repurchases as a percent of net income)  
Note: A negative DPR or RPR shows the relation between the level of dividends or repurchases and negative net income.  
Source: IBM Annual Reports

This change reflects IBM's much greater orientation toward product development than to basic research. As the company states in its 2003 Annual Report: "A key transformation that has been taking place over the past decade and that continues today is the change in the focus and the culture of IBM's R&D organization to be more closely linked to and be primarily driven by industry-specific and client-specific needs."<sup>140</sup> A major element of this strategy is extensive patenting for the purposes of cross-licensing and IP (intellectual property) revenue generation.<sup>141</sup> Cross-

<sup>140</sup> IBM Annual Report, 2003, p. 49.

<sup>141</sup> Peter C. Grindley and David J. Teece, "Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics," *California*

licensing has enabled IBM to gain access to technology developed by other companies rather than generating that technology through in-house R&D. IBM sees its IP revenues, which averaged \$1.352 billion per year in 2000-2003, as a direct return on its R&D expenditures, which averaged \$5.154 billion over the same period.<sup>142</sup>

Since 1993, IBM has emerged as the leader in U.S. patent awards. During the 1990s, as IBM scaled back its rate of R&D expenditure, it ramped up its patenting activity. In 1989 and 1990, IBM was ninth in number of U.S. patents awarded; in 1991, eighth, and in 1992, sixth. With a 29 percent increase in patents awarded in 1993 over 1992, however, IBM moved into the number one spot, and has maintained that position for twelve years through 2004. As can be seen in Figure 8, IBM's level of patenting activity has created a widening gap between IBM and its rivals.

During the last half of the 1990s, while IBM was using its IP as the basis for multibillion-dollar OEM partnerships with other ICT companies such as 3Com, Acer, Cisco, Dell, and EMC, it was also taking the lead among Old Economy companies in outsourcing routine production to contract manufacturers.<sup>143</sup> For example, in 1999, IBM outsourced its printed circuit board assembly for motherboards used in its mobile products to Solectron in a deal that was the second largest in the contract manufacturer's history and that included the transfer of 1,300 production workers based in Austin, Texas, from IBM to Solectron.<sup>144</sup> IBM also had major supply agreements with Celestica, one of the top five CMs, which had originally been IBM Canada, the parent company's manufacturing arm.

IBM had spun off IBM Canada in 1994 as part of a restructuring process that saw IBM downsize its labor force from 374,000 in 1990 to 220,000 in 1994, in the process making history of the company's commitment to offering employment for one's working life. Much of IBM's restructuring in the early 1990s had been accomplished by making it attractive for IBM employees to take early retirement at age 55. Those restructuring charges were largely responsible for IBM's \$16 billion in losses in 1991-1993. In 1995, IBM rescinded this early-retirement provision, not only because it had accomplished its purpose, but also because, in its efforts to compete for younger talent in the New Economy

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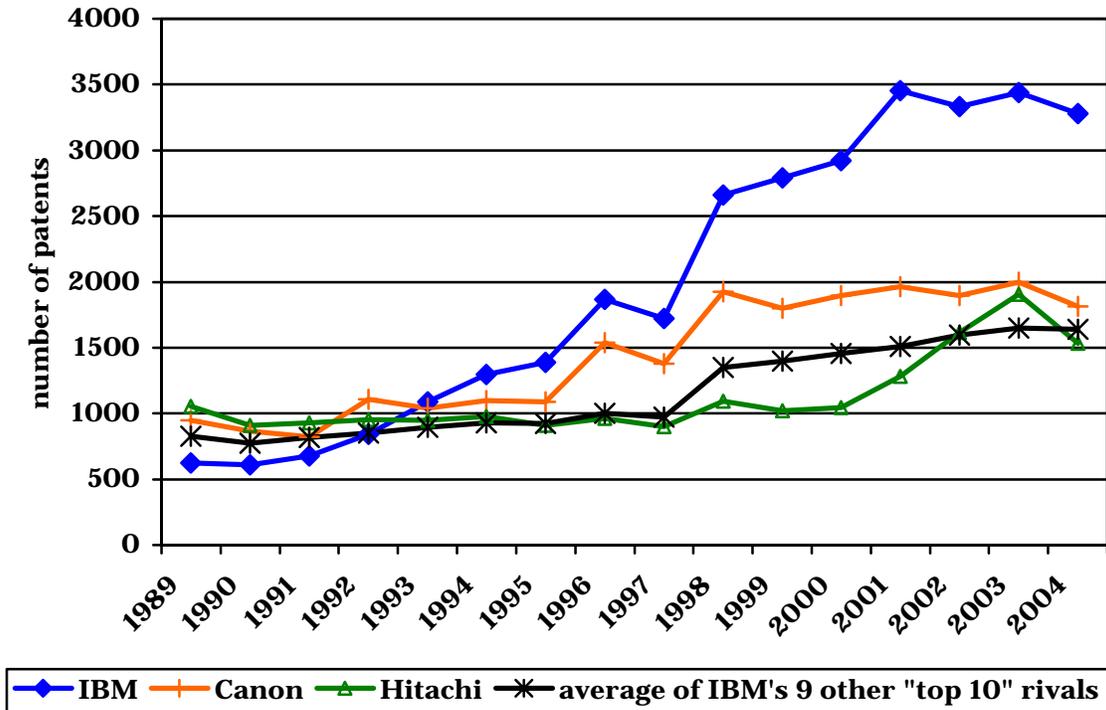
*Management Review* 39 (Winter 1997): 8-41; Lisa DiCarlo, "IBM Cashes In: Wielding a Massive Arsenal of Patents Big Blue Shakes Up The High-Tech Industry," *PC Week*, 20 Sept. 1999.

<sup>142</sup> *IBM Annual Report*, 2002, p. 52; *IBM Annual Report*, 2003, pp. 54, 82.

<sup>143</sup> DiCarlo, "IBM Cashes In."

<sup>144</sup> *PR Newswire*, 6 Jan. 1999.

FIGURE 8  
U.S. Patenting, IBM, Leading Japanese Electronics Companies  
and Other Top 10 Patenters, 1989-2004



Source: <http://www.ificlaims.com>.

labor market, the company no longer wanted to encourage all employees to stick around until the age of 55.<sup>145</sup> IBM's new emphasis on cross-licensing and technology partnerships, for example, made it much more desirable and possible for the company to make use of a fluid and flexible high-tech labor force.

That labor market logic was taken a major step further in 1999 when IBM announced that it was shifting from its traditional pension plan, which gave older workers retirement benefits based on their pre-retirement salary levels, to a "cash-balance" pension plan that paid annually into an account for each employee 5 percent of the employee's salary for that year plus annual interest (based on market rates) on accumulated balances. IBM also moved to a similar type of cash-balance

<sup>145</sup> Ellen Schultz, "Pension Cuts 101: Companies Find Subtle Ways to Pare Retirement Benefits," *Wall Street Journal*, 27 July 2000.

plan for retiree health benefits.<sup>146</sup> The cash-balance pension was defined-benefit, but also portable should the employee leave the company. IBM designed it to attract younger employees who, in the New Economy, did not expect to spend their whole careers with one company. Of 141,000 people in IBM's U.S. labor force in 1999, 60,000 had joined the company since 1993. In a communication to employees announcing the change in the pension plan, IBM's management wrote: "The fact that significantly fewer people are staying with one company their full careers means that, more and more, people are looking for opportunities to contribute and be rewarded sooner in their careers."<sup>147</sup> IBM employees were also told that "competition in our industry for skilled, talented employees has never been more fierce than it is today."<sup>148</sup> IBM did permit some 30,000 employees who were within five years of the thirty years of service required for retirement to remain on the traditional plan.

While the company also provided extra contributions to the cash-balance plans of other employees age 45 or older, it was estimated that these mid-career employees could lose 30 to 50 percent of their expected pensions.<sup>149</sup> They did not accept the change quietly. Suddenly some IBM employees became receptive to union organizing efforts, and three years later 5,000 of them had joined Alliance@IBM, an affiliate of the CWA.<sup>150</sup> Moreover, federal legislators got involved. IBM was the biggest employer in Vermont, and Bernard Sanders, the state's lone member of the U.S. House of Representatives, charged that IBM's cash-balance plan violated federal laws against age discrimination.<sup>151</sup> Vermont Senator James Jeffords, also the chair of the Senate Health, Education, Labor and Pensions Committee, convinced IBM CEO Gerstner to permit those IBM employees who were at least 40 years old and had at least ten years of service—some 65,000 people—to remain in the traditional plan.<sup>152</sup> The SEC blocked IBM management's attempt to disallow a vote on the cash-

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<sup>146</sup> Jerry Geisel, "IBM Debuts Innovative Health Plan for Retirees," *Business Insurance* 24 (May 1999): 1.

<sup>147</sup> Diane E. Lewis, "Change in Pension Plan Stirs Union Talk at Big Blue," *Boston Globe*, 25 July 1999.

<sup>148</sup> Carol Frey, "IBM Makes Pension Plan More Attractive to Younger Workers," *News & Observer* (Raleigh, N.C.), 4 May 1999.

<sup>149</sup> See Lewis, "Change in Pension Plan Stirs Union Talk at Big Blue"; Kathleen Lynn, "For Older Workers, Cash-Balance Pension Plans Can Hurt," *The Record* (Hackensack, N.J.), 20 May 1999.

<sup>150</sup> Benjamin Pimentel, "As Tech Jobs Decrease, Interest in Unions Is Up," *San Francisco Chronicle*, 18 July 2002.

<sup>151</sup> Vineeta Anand, "Big Blues: IBM's Conversion Draws Watchdogs: Switch to Cash Balance Plan Raises Concern from Lawmakers about Age Discrimination," *Pensions & Investments*, 6 Sept. 1999, p. 1.

<sup>152</sup> *Dow Jones Business News*, Sept. 17, 1999; John Affleck, "IBM Shareholders Reject Return to Traditional Pension Plan," *Associated Press Newswires*, 25 April 2000.

balance plan at the annual shareholders' meeting, thus rejecting IBM's claim that the pension plan was a matter of ordinary business that did not require shareholder approval.<sup>153</sup>

Shareholder proposals to permit employees to choose among pension plans failed at five successive annual meetings from 2000 through 2004, but nevertheless received unusual levels of support that reflected the animosity of employee-oriented shareholders to the cash-balance plans.<sup>154</sup> Meanwhile, a class action lawsuit, covering anyone who worked for IBM after December 31, 1994, was brought against the company on the grounds that changes in IBM pensions discriminated against older employees, and hence violated ERISA.<sup>155</sup> In September 2004, IBM agreed to a settlement consisting of \$320 million that was not subject to appeal, plus another \$1.4 billion should it lose its appeals of a lower court's decision.<sup>156</sup> As of December 2004, the appeal process had not yet been completed, but IBM had announced that new employees would not be eligible for the cash-balance pension fund. Instead, the company would offer them a defined-contribution 401(k).<sup>157</sup>

When IBM had instituted the cash-balance plan in 1999, management had stated that it would redirect the \$200 million per year that it would save on the new plan into stock options for 23,000 "key" employees.<sup>158</sup> As under Gerstner, the company discarded lifelong employment; it implemented a broad-based stock option program. In 1992, 1,300 executives, or less than half of 1 percent of IBM's total labor force, had received stock options, whereas in 2001 options went to 72,500 people, or almost 23 percent of the labor force.<sup>159</sup> IBM's increased reliance on

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<sup>153</sup> Judith Burns, "SEC Tells IBM It Can't Stop Vote on Pension Plan," *Dow Jones News Service*, 16 Feb. 2000.

<sup>154</sup> Affleck, "IBM Shareholders Reject Return to Traditional Pension Plan"; Donna Fuscaldo, "IBM Shareholders Vote on Proposal Attacking Pension Plan," *Dow Jones News Service*, 24 April 2001; Bob Freund, "IBM Stockholders Reject Pension Proposal," *Post-Bulletin* (Rochester, Minn.), 30 April 2002; Anne Krishnan, "IBM Shareholders Reject Pension Choice Proposal for Third Time," *Herald-Sun* (Durham, N.C.), 30 April 2003; Lynn Ardit, "Angry Shareholders, Workers, Retirees Speak Out at IBM's Annual Meeting," *Providence Journal* (R.I.), 28 April 2004.

<sup>155</sup> Brian Tumulty, "Age Bias Claim Tested in IBM Pension Conversion Case," *Gannett News Service*, 5 June 2003a.

<sup>156</sup> Arden Dale, "Judge Rules IBM Must Make Back Payments in Pension Case," *Dow Jones Newswires*, 18 Feb. 2004; Arden Dale, "Update: IBM Pension Settlement Leaves Unresolved Issues," *Dow Jones News Service*, 30 Sept. 2004; Rob Wells, "US House Backs Court Cash Balance Pension Plan Decision," *Dow Jones International News*, 22 Sept. 2004.

<sup>157</sup> *AFX International*, 9 Dec. 2004.

<sup>158</sup> Brian Tumulty, "Documents Reveal IBM's Reason for Pension-Plan Change: Saving Money," *Gannett News Service*, 5 June 2003b.

<sup>159</sup> Gerstner, *Who Says Elephants Can't Dance?* 97.

options over the past decade is evident in Figure 9; since 1997, the “burn rate” (options granted/stock outstanding) has been 2.51 percent, and the “overhang” (options outstanding/stock outstanding) has soared from 6.3 percent to 13.6 percent. While IBM employees no longer had the promise of lifelong employment with the company, and while the prospective pension returns of many of them were being eroded, much larger numbers benefited from the 600 percent increase in the company’s stock price during the last half of the 1990s. Foremost among the beneficiaries was Gerstner, who during his decade at IBM made \$311 million (75 percent of his total IBM income) by exercising 38 percent of the options he had been granted, with 95 percent of the value of exercised options being realized in 1998-2001.<sup>160</sup>

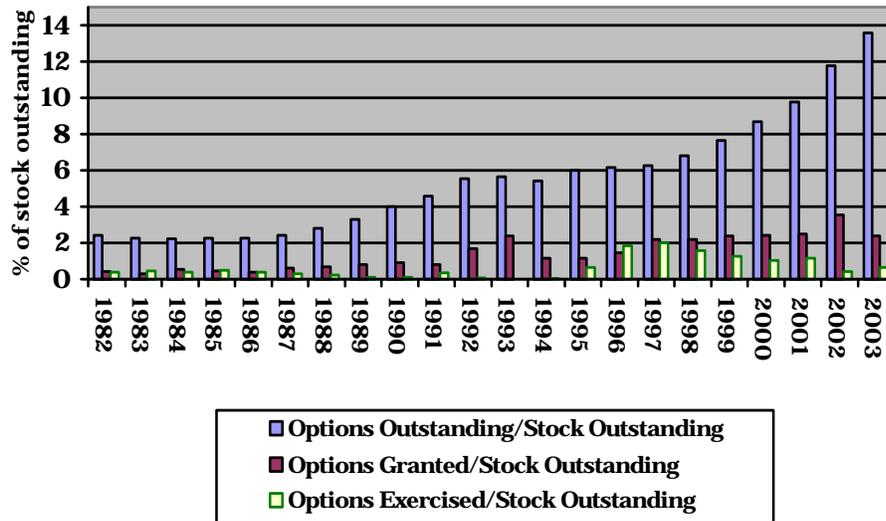
In line with the transformation of IBM’s employment relations to conform to NEBM practice, the company also changed its financial behavior (see Figure 7). In 1991 and 1992, as IBM was incurring a two-year total of \$7.8 billion in losses, it paid \$2.8 billion in dividends per year, thus maintaining its dividend payments at the same amount that it had paid in each of the previous two years when it had a total of \$9.8 billion in profits. Then, in 1993 with its losses at \$8.1 billion, IBM cut its dividend payments to \$0.9 billion, just 35 percent of its average payment level over the previous decade. Subsequently, as profitability returned, IBM cut its dividend payments further before gradually increasing them from 1995, but to a lower level than prior to the cut. Whereas IBM had paid out 48.4 percent of its net income in dividends over the decade 1981-1990, it reduced this payout rate to only 14.1 percent over the decade 1994-2003, thus moving the company much closer to the practice of its New Economy competitors, who, as we have seen, tend to pay few, if any, dividends.

This dramatic reduction in IBM’s dividend payout rate (DPR) does not mean, however, that IBM has been distributing less cash to shareholders, as can be seen in Figure 7. In 1995, when IBM reduced its dividends to a low of \$591 million, it did stock repurchases of over eight times that amount. While its DPR was only 14.1 percent in that year, the repurchase payout rate (RPR) was 116.4 percent. IBM had previously carried out large-scale stock repurchases in 1986-1989, but the RPR for those years was 29.4 percent, while the DPR was 55.5 percent. By contrast, for the period 1995-2003, the DPR was 13.7 percent while RPR was 92.6 percent, with repurchases totaling \$52.5 billion, ranging from \$4.2 billion in 2002 to \$7.3 billion in 1999.

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<sup>160</sup> IBM Proxy Statements, various years.

FIGURE 9  
IBM's Stock Options, 1982-2003



Source: IBM *Annual Reports*

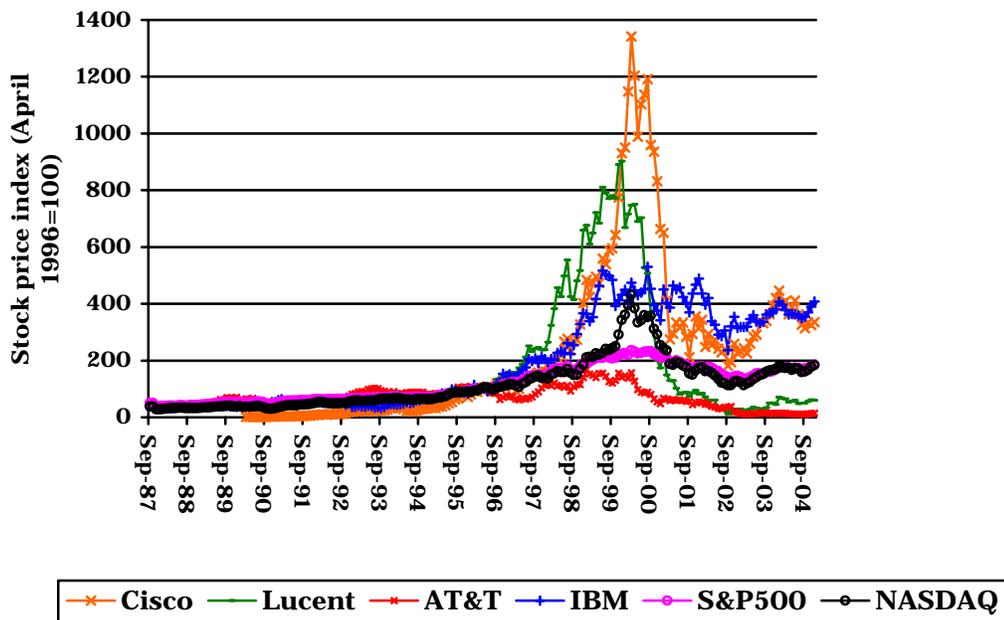
Driving this repurchasing policy was IBM's employment policy, focused as it was on using stock options to compete for mobile labor and making top managers (very) rich. IBM's massive and persistent stock repurchases since 1995 undoubtedly helped to sustain its stock price. As can be seen in Figure 10, IBM's stock price took off in the last half of 1998. Although its stock price increase did not compare with that of Lucent or Cisco, it nevertheless outperformed the NASDAQ Index, and, unlike Lucent and Cisco, has remained relatively stable since the peak of the Internet boom.

IBM, therefore, has made the transformation to NEBM, and indeed has helped to redefine the way in which firms innovate and compete based on this model. Strategically, IBM became much more focused on development than on research—on commercializing its existing capabilities rather than on accumulating new capabilities. It began to move down that strategic path when at the beginning of the 1980s it launched the PC by capitalizing on its brand name and marketing organization, while relying on other technology companies to supply it with critical hardware and software. Organizationally, IBM has dramatically changed the terms on which it employs people, a transformation that began in the early 1990s as it slashed its huge work force by more than 40 percent in the space of four years, incurring enormous restructuring charges as the cost of ending the tradition of lifelong employment. It then, as we have seen, aligned its

retirement system with its New Economy employment relations based on mobile labor. Financially, IBM has substantially changed the way in which it distributes returns to shareholders, moving away from dividend-based returns toward price-based returns, because of its reliance on stock options as a mode of compensation. The result is that between 1995 and 2003 the company spent \$52.5 billion on stock repurchases, almost \$8 billion more than it spent on R&D.

Observing the relation between the trends in the rate of R&D expenditures and the value of stock repurchases displayed in Figure 7, one might conclude that the rise in the latter is the reason for the decline in the former. Such is not the case; IBM could and would spend more on R&D if it fit its business model. The trend in R&D expenditures as a percent of sales reflects the new way in which IBM transforms technological capabilities into revenues, while the rationale that underlies the stock repurchase program has been the need to sustain its stock price to attract and retain the high-tech personnel to carry out that transformation. Both trends reflect IBM's version of NEBM.

FIGURE 10  
 Stock Price Movements, Cisco, Lucent, AT&T, and IBM  
 Compared with the S&P500 and NASDAQ Indices



Source: Yahoo! Finance.

### Some Questions about the Future of NEBM

IBM has clearly been successful in adopting its version of NEBM. However, how sustainable is this business model both at IBM and in the ICT industries generally? How will NEBM affect the globalization of the ICT industries? What are the implications of NEBM for ICT employment opportunities in the U.S. economy? The purpose of my ongoing research is to generate answers to these questions; I will not try to answer them here. Let me simply conclude by highlighting three interrelated areas of concern in what might be called the economics of NEBM.

First, NEBM may more fully exploit existing knowledge, but it may also under-invest in new knowledge. In historical perspective, NEBM would not have come into existence without the decades of investments in basic research that were undertaken by the U.S. government and corporate labs in the Old Economy. What is the New Economy equivalent of this knowledge-creation process? In addition, why are not more of the returns to those investments in basic research being reallocated to the source from whence they came? From a national perspective, how should the allocation of returns from long-term developmental investments be governed?

Second, NEBM now has access to a global labor supply of educated and experienced ICT labor. NEBM draws upon a highly developed system of ICT education and training. While the United States has been the world leader in the provision of high-tech education, the high-tech labor advantage has been shifting to Asia and Europe (both East and West) as those areas of the world have upgraded the quality of the primary, secondary, and university education that they provide to more of their populations. Indeed, it would appear that these well-educated foreign nationals have become better prepared to benefit from U.S. ICT educational offerings than the U.S. population itself. Moreover, largely as a result of large-scale U.S. non-immigrant visa programs—specifically the H-1B visa program for highly educated scientific and technical personnel purportedly in short supply in the United States and the L-1 visa program for employees of multinational corporations—hundreds of thousands of foreign nationals, most notably from India, have been able over the past decade or so to accumulate years of valuable on-the-job high-tech experience in the United States. Some have subsequently become U.S. nationals, while many have returned to their homelands, where they are employed by indigenous high-tech companies or by the off-shored operations of multinational corporations. The result has been a globalization of the potential benefits of ICT development. The workers involved in this global labor market compete for jobs, however, at dramatically varying rates of pay and work conditions. Should this global labor supply be subject to global regulation? If so, how, and by whom?

Third, and finally, ICT workers in the United States face a very uncertain future. In the evolution of NEBM, the lure of working for a

smaller technology company with the potential of stock-based gains led many professional, administrative, and technical workers to choose relatively insecure employment in the New Economy rather than secure employment in the Old Economy. In the 1980s and 1990s technological opportunity, venture creation, and the longest bull run in U.S. stock market history helped to deliver the promise of the New Economy to these workers. The extent of their income gains in the Internet boom is clear in Figures 4 and 6. In the 2000s, however, the world of employment for ICT workers has changed. They cannot necessarily choose between working in the Old Economy and New Economy; among U.S. ICT companies at least, OEEM no longer exists. The successful New Economy companies have grown much bigger, and, as shown in Figures 1 and 9, their employee stock option “overhang” has grown much larger, creating more potential dilution. Few companies can afford to support their stock prices through stock repurchases on the scale of IBM and Cisco. At the same time, however, it is not at all clear that in the current labor market environment, ICT companies will have to rely to the extent that they have in the past on stock options to attract and retain a broad base of employees. There now exists a global surplus of educated and experienced ICT labor accessible to U.S. ICT firms at much lower wages than those that prevail in the United States. In the last decades of the twentieth century, the evolution of NEEM was driven by the interfirm mobility of labor. In the first decades of the twenty-first century, the evolution of NEEM may well be driven by the international mobility of capital.